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**REPORT
ON
STATE TUBE-WELLS
(UTTAR PRADESH)**

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**COMMITTEE ON PLAN PROJECTS
(Minor Irrigation Team)
NEW DELHI.**

October, 1961

LETTER OF TRANSMITTAL

Dr. A. N. KHOSLA,
Member.

PLANNING COMMISSION,
NEW DELHI.

September 26, 1961.

My dear Shri Shastri Ji,

The Team for Minor Irrigation of which I was the Leader sometime back, has prepared a Report on Tubewells in U.P. This Report has taken some time to materialise in view of the important issues which had to be considered in relation to the lessons to be learnt from the great experiment which the U.P. Government undertook, over a period of years, to intensify its efforts for providing irrigation facilities. The Report raises several important issues regarding the factors which should be taken into account in sanctioning programmes of this nature. It also deals with a number of aspects of agricultural planning which need special care and attention so that the benefits of water utilisation could be maximised both for the people and the Government.

2. Some of the issues raised are very pertinent; they may even be somewhat controversial but it is the essence of reporting by the teams of the Committee on Plan Projects that they bring out the essential aspects of planning and implementation in the particular fields in which they conduct studies. The objective is that maximum instructions should be drawn for closing the gap in present implementation and for future planning. The Team will be well repaid if it provokes constructive thinking in this field which is very vital to improvements in agricultural production and the standard of living of the rural community.

3. In the end I must thank the U.P. Government for the co-operation it has given to the Team in supplying the necessary data and in taking keen interest in discussing the various issues raised.

4. The draft Report was seen by the U. P. Government and their comments have been taken into consideration in compiling the final report; any further comments of the U.P. Government will be printed separately as an Appendix to the Report as and when they are received.

Yours sincerely,
A. N. KHOSLA.

Shri Lal Bahadur Shastri,
Chairman,
Committee on Plan Projects,
NEW DELHI.

PREFACE

The Minor Irrigation Team appointed by the Committee on Plan Projects undertook the study of State Tubewells in Uttar-Pradesh, as a part of the programme laid down in the Terms of Reference, communicated *vide* Committee on Plan Projects Memorandum No. COPP/(4)/17/58 dated the 4th August, 1958, contained in Appendix XII of this Report. The Team comprised Shri N.V. Gadgil, Leader; Shri M. Narasimhaiya, Retired Chief Engineer, Mysore; Shri Lal Singh, Retired Director of Agriculture, Punjab, Members and Shri Mahavir Prasad, Irrigation Adviser to the Ministry of Food and Agriculture, Member *Ex-Officio*.

Shri N. V. Gadgil relinquished the Leadership of the Team on 26th September, 1959 and Dr. A. N. Khosla took his place.

Shri M. Narasimhaiya ceased to be a Member of the Team from 22nd February, 1959. His place was later taken by Shri Baleshwar Nath, who joined the Team as Chief Engineer, (Addl.) on March 8, 1960 and was entrusted with the task of reconciling the varying view points and finalising the Report.

The Team, besides individual and group-wise field studies, also examined the performance data of the State tubewells in Uttar Pradesh for the past twenty-five years or so. Discussions were held with the State authorities, both at Lucknow and New Delhi.

The recommendations of the Team deal with many aspects of tubewell development in the State. Certain procedural and administrative measures have been suggested besides technical recommendations, with a view to maximise the benefits resulting from tubewells. 'Investment-return' criterion of the tubewell undertaking has also been critically examined by the Team, as it has a great bearing on future planning of tubewell programme.

We take this opportunity to express our gratitude to the Chief Engineer of the State, Shri A. C. Mitra; the Director of Agriculture, Dr. B. K. Mukerji and to other officers of the State Government for their co-operation.

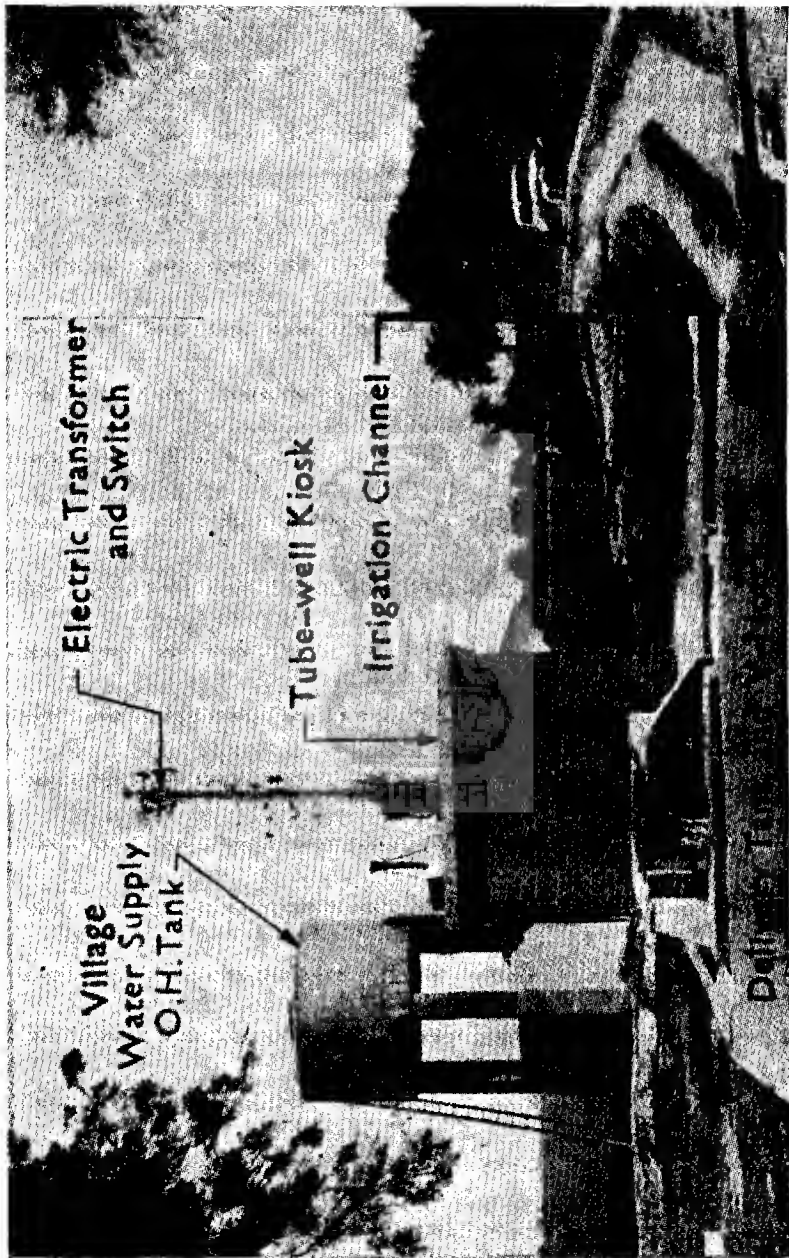
Shri Indarjit Singh, Secretary, Committee on Plan Projects and Shri R. S. Chadda, Deputy Secretary have been of considerable help in the finalisation of this Report. Our thanks are due to them also.

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A Tubewell in operation

CHAPTER—1

Need for Tubewell Irrigation in Uttar Pradesh and its Growth

1.1. Climatic Features—The State of Uttar Pradesh comprising 1,13,410 square miles of area lies in a climatic belt, which can be best described as monsoon-tropical. It has three pronounced seasons, namely a cold period from October to February with temperature ranging from 10° to 27°C. (50° to 80°F.), a hot season from March to mid-June with temperature from 38° to 46° C. (100° to 115°F.) and a wet monsoon period from mid-June to September with warm temperature generally around 32°C. (90°F.) and humidity from 60 to 80 percent. Practically all rain falls during the monsoon period. It varies from 20 inches to 60 inches, gradually increasing from West to East, and is far higher in the extreme North, where it is augmented by air currents rising against Himalayan range.

1.2. Land Configuration and Soils—The main agricultural areas of the State are located in the broad, nearly flat but gently eastward sloping plains within the river basins of Ganga and its tributaries. The type of soils consist of deep rich alluvials, generally silty with varying admixture of sand and clay. Due to insufficiency or seasonal shortage of rain, the area had stood in need of artificial irrigation for ages. Most of its available river supplies, which fortunately are perennial, had been appropriated during the past 125 years in a number of canal systems—the two most prominent being the Ganga and the Sarda, which are each capable of carrying a head discharge of the order of 10,000 cusecs. There still remained vast areas, particularly in the localities of uncertain rainfall, which needed planned and dependable irrigation to guard against failure of crops during periods of drought and to ensure increased food production even during normal years.

1.3. Most of these areas are fortunately underlain by thousands of feet of stream sediments, which are unconsolidated and contain good water bearers or strata (aquifers) such as medium and coarse sands, inter-stratified with beds of clay and silty clay. Limestone (*Kankar*) is also sparingly present, but it is of such minor constituent that it can be bored through. Good water bearing strata (aquifers) are relatively scarce in the strip of the country flanking Himalayan foot-hill commonly called Tarai. In this area at a large number of places the clay layers overlying the aquifers are slightly tilted creating thereby hydro-static pressure in the

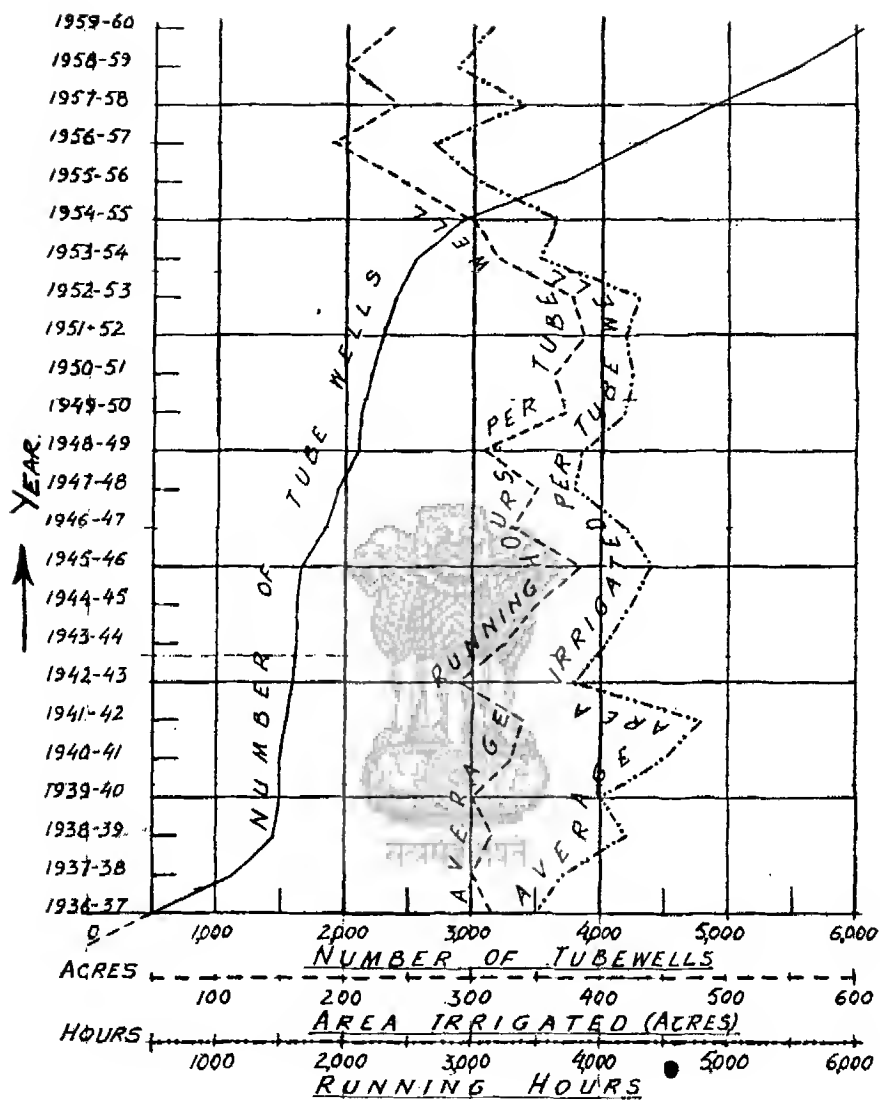


FIGURE 1'1 :—Graph showing progress of constructions of New Tubewells and corresponding average performance per tubewell in Uttar Pradesh.

aquifers. Such aquifers when reached by boring result in artesian wells. These confined beds lie within the depths of 200 to 350 feet below ground level and consist of sands and gravels capped by clays. Quality of water is consistently good. Uttar Pradesh plains are, therefore, considered suitable for tubewell drilling operations.

1.4. The thickness of sand aquifers available within the boring depths of 300 feet being sufficient for yield of adequate discharge for agricultural purposes, some private tubewells had been installed in the past by wealthy land owners and were operated with oil engines. But in those days they faced many working difficulties besides involving heavy capital outlay and recurring maintenance costs. When, however, cheap electric power was made available on Ganga Canal falls, the State authorities formulated a plan to instal tubewells in the western districts with a view to providing irrigation in the areas not till then commanded by canals.

1.5. **Tubewell Programme.**—The first State Tubewells project was thus commenced in 1931. It comprised 1,656 tubewells and was intended to serve areas mostly in Meerut and Rohilkhand Civil divisions. Later on, a project for the construction of 600 additional tubewells in the same area was taken up in the year 1945 and completed in 1951. Under these projects the total number of State tubewells completed by end of March 1946 was 1,847 with a capital outlay of Rs. 2.44 crores. The overall cost per tubewell then worked out to Rs. 13,210/-. The tubewells irrigated an area of 7,45,145 acres during the year 1945-46.

1.6. During the period 1946-47 to 1950-51 both inclusive, 458 tubewells at an average cost of Rs. 44,800 each were built involving an outlay of Rs. 2.05 crores. Thus towards the end of March, 1951 the number of tubewells was 2,305 and the area irrigated from the State tubewells was 9,37,137 acres.

1.7 Expansion of tubewells programme during the two Five Year Plans, now extending even to eastern districts of the State has, however, been very pronounced. During the First Five Year Plan construction was taken up on 200 tubewells in Meerut division, 51 tubewells in western districts (on which work had already started earlier) and another 3,000 tubewells all over the State. As a result of that drive towards the close of First Five Year Plan the number of tubewells in the State was around 4,000. The total capital outlay during the Plan period stood at Rs. 6.48 crores and the area irrigated during the year 1955-56 was 11,29,277 acres.

1.8. During the Second Five Year Plan period, tubewells already taken up during the First Five Year Plan were completed and construction of another 1,500 tubewells, as scheduled in the Second Five Year Plan, was taken up. The overall cost of a tubewell during the Second Plan is

reported to be Rs. 43,000 and the total capital outlay on State tubewells from the very beginning to the end of the year 1957-58 is reported to be Rs. 270.78 crores. The number of tubewells operating during the year was around 5,000 and the area irrigated was 16,93,725 acres. A statement showing progressive growth of tubewells, area irrigated in acres, average area irrigated per tubewell in acres, total running hours and average running hours per tubewell from 1936-37 to year 1959-60 is given in Table I.1.

1.9. General Observations.—As the statement will show there has been a large increase in the number of tubewells during the First and Second Plan periods. Whereas the number of wells in 1951 was a little over 2,000, it exceeded the figure of 6,000 in the year 1959-60. Figure 1.1 gives the average number of running hours and average area irrigated per tubewell in the State. There has been a decline in these averages with the increasing number of tubewells. Whereas the average area irrigated per tubewell was 482 acres in 1941-42 it was only 271 acres in 1956-57. There is a similar difference between the average number of running hours per tubewell which was 3,370 in 1941-42, was 1,886 in 1956-57 and 2,350 in 1959-60. Appendix I provides a general picture of the performance of the Tubewells during the recent years. Apparently, there is room for improvement in operation of tubewells, water and field management, and agricultural development activities in the tubewell project areas, as will be indicated in subsequent chapters.

TABLE I.1

Statement showing number of Tubewells in operation in the beginning of any year from 1936-37 to 1959-60 alongwith their performance

Year	No. of Tubewells in operation	Total Area irrigated in acres	Average area irrigated per T. well in acres	Total Running Hours	Average Running Hours per Tubewell
1	2	3	4	5	6
1936-37 . .	533	1,88,297	353	16,93,569	3,177
1937-38 . .	1127	4,19,577	372	33,54,363	2,976
1938-39 . .	1447	6,17,793	423	45,91,331	3,173
1939-40 . .	1471	5,91,967	402	43,82,229	2,975
1940-41 . .	1485	6,73,355	453	49,11,427	3,307
1941-42 . .	1562	7,52,359	482	52,64,640	3,370
1942-43 . .	1619	6,09,023	376	46,30,975	2,860
1943-44 . .	1641	6,66,621	406	53,50,460	3,260
1944-45 . .	1649	6,98,822	424	57,60,652	3,493
1945-46 . .	1687	7,45,145	442	65,41,093	3,877
1946-47 . .	1847	7,76,064	420	64,71,238	3,341
1947-48 . .	1956	7,41,180	379	67,80,495	3,478

1	2	3	4	5	6
1948-49 . .	2085	8,04,412	386	64,31,240	3,084
1949-50 . .	2131	8,97,293	421	79,50,671	3,731
1950-51 . .	2200	9,37,137	426	79,66,531	3,621
1951-52 . .	2305	9,61,371	417	89,36,983	3,877
1952-53 . .	2393	10,26,689	433	90,28,800	3,773
1953-54 . .	2554	9,03,194	354	81,37,549	3,186
1954-55 . .	2932	10,97,664	368	87,99,978	3,001
1955-56 . .	3686	11,29,277	306	86,85,517	2,356
1956-57 . .	4268	11,56,977	271	80,50,948	1,886
1957-58 . .	4928	16,93,725	340	1,17,15,777	2,377
1958-59 . .	5559	15,90,378	286	1,12,40,398	2,022
1959-60 . .	6048	18,97,798	314	1,42,12,800	2,350

1.10. Tubewells are a very important economic asset created during the last 25 years. Their management is, therefore, a vital subject bearing on the agricultural economy of the State. It has three aspects, namely, of increasing the food resources of the State ; increasing the well-being of agricultural population and increasing the return to the State on its investment. All the three propositions are interlinked. If the return to the community is greater, the return to the State is bound to show an increase automatically. The importance of tubewells may be appreciated in the perspective of very little possibility of exploiting further the surface water resources of the State. It was for this reason that this study was undertaken.

CHAPTER—II

Organisational set-up

2.1. State tubewells in Uttar Pradesh are under the general technical and administrative control of the Chief Engineer, Irrigation Department. They are jurisdictionally divided into administrative units, known as Tubewell Circles, each Circle being under the charge of a Superintending Engineer. The Superintending Engineers are responsible for the construction, maintenance and upkeep of tubewells and their appurtenant works including preparation of revenue accounts in their respective Circles. A Circle is further divided into three or four tubewell divisions. A tubewell division is the executive unit under the charge of an Executive Engineer, with three or more sub-divisions attached to it. To each division is also attached a Deputy Revenue Officer, who supervises the work of the revenue staff and also exercises magisterial powers under the Canal Act.

2.2. Field Operation Staff.—The actual field operation staff works under the Sub-divisional officer or Assistant Engineer. The field staff in a sub-division consists of three to four overseers, three to four electrical-mechanical supervisors and other subordinate staff on regular pay-rolls or on work-charge basis. Normally each overseer and each supervisor look after 50 to 60 tubewells with regard to civil and mechanical works respectively. On the revenue side, there is one *Ziladar* along with *Amins* and tubewell operators in each sub-division. A tubewell operator is parallel to Patrol or *Patwari* and is the pedestal of official set-up of tubewell organisation. He runs the tubewells. He keeps account of irrigated areas, field by field, and also of the charge levied thereon. Besides, he keeps a watch on the demand for irrigation and advises cultivators on matters pertaining to use of tubewell water.

2.3 During the season and at the end of the '*Fasal*' field-wise record maintained by the operators, are checked by *Amins* and *Ziladars* and individual demand slips are prepared. On the basis of these records (consolidated account of assessment) *Jamabandis* are prepared in the office of the Executive Engineer under supervision of the Deputy Revenue Officer and are forwarded to the Revenue authorities for collection of charges. Finally, the performance of a tubewell is judged by the gross receipts indicated by the *Jamabandi*.

GROUP-WISE LIST
ANNEXURE TO FIG. 2-1.

Map Index No. 1	Group 2	Tube well circle 3	Map Index No. 1	Group 2	Tube well circle 3
Category—A			Category—C—Contd.		
A1 .	North Loi	Meerut	C13	Islamnagar.	Moradabad
A2 .	South Loi	"	C14	Bisauli	"
A3 .	Kakra	"	C15	Narora.	Meerut
A4 .	Daha	"	C16	Sahaswan	Moradabad
A5 .	Lohara	"	C17	Budaun.	"
A6 .	Ghaziabad	"	C18	Kakrala.	"
A7 .	Sikandrabad	"	C19	Kaimganj.	Meerut
A8 .	Shikarpur	"	C20	Farrukhabad.	"
A9 .	Agra	"	C21	Chibramau.	"
Category—B			C22	Bithur.	"
B1 .	Kairana	Meerut	C23	Bhogaon.	"
B2 .	Jansath	"	C24	Mainpuri	"
B3 .	Sardhana	"	C25	Karhal.	"
B4 .	Meerut	"	C26	Bah.	"
B5 .	North Bhatipura	"	C27	Jasrana.	"
B6 .	South Bhatipura	"	C28	Marhara.	"
B7 .	Hapur	"	C29	Khurja	"
B8 .	Upera	"	C30	W. Khair.	"
B9 .	Kithor	"	C31	E. Khair.	"
B10	Kuchesar	"	C32	Aligarh.	"
B11	Jahangirabad	"	C33	Iglas.	"
B12	Sirsi	Moradabad	C34	Hathras.	"
B13	Bilari	"	C35	Mahrajunj.	Gorakhpur
B14	Gan gan	"	C36	Padrauna.	"
B15	Shahabad	"	C37	Deoria.	"
B16	Dibai	Meerut	C38	Rasra.	Varanasi
B17	Atraoli	"	C39	Bansdih	"
B18	Kasganj	"	C40	Saidpur.	"
B19	Shikohabad	"	C41	Kerakat.	"
Category—C			C42	N. Varanasi.	"
C1 .	Deoband	Meerut	C43	S. Varanasi.	"
C2 .	Muzaffarnagar	"	C44	Bhadoi.	"
C3 .	Bijnor	Moradabad	C45	Jaunpur.	"
C4 .	Nahatur	"	Category—D		
C5 .	Dhampur	"	D1 .	Saharanpur.	Meerut
C6 .	Chandpur	"	D2	Nakur.	"
C7 .	Amroha	"	D3	Roorkee.	"
C8 .	Sarkara	"	D4	Bijnor Canal.	Moradabad
C9 .	Panwaria	"	D5	Loni.	Meerut
C10	Sambhal	"	D6	Hasanpur.	Moradabad
C11	Chandausi	"	D7	Bajar Patli.	"
C12	Bahjoi.	"	D8	Aonla.	"
			D9	Aliganj.	Meerut

1	2	3	1	2	3
Category—D—contd.			Category—F—contd.		
D10	Etah.	Meerut	F6	Bulandshahar.	Meerut
D11	West Pawanyan.	Moradabad	F7	Thakurdwara.	Moradabad
D12	West Mohmadi.	"	F8	Bazpur.	Bareilly.
D13	Kannauj.	Meerut	F9	Bilaspur.	"
D14	Misrikh.	Moradabad	F10	Baheri.	"
D15	Lucknow.	"	F11	Pilibhit.	Bareilly—1 Moradabad—2
D16	Gonda.	"	F12	Bareilly.	Bareilly
D17	Domoriaganj.	Gorakhpur	F13	Puranpur.	Moradabad
D18	Faizabad.	Moradabad	F14	Dataganj.	"
D19	Haraiya.	Gorakhpur	F15	Shahjahanpur.	"
D20	Bikapur.	Moradabad	F16	Sikandra rao.	Meerut
D21	Basti.	Gorakhpur	F17	Mathura.	"
D22	Sultanpur.	Moradabad	F18	Jalalabad.	Moradabad
D23	Kadipur.	"	F19	Shahabad.	"
D24	Khalilabad.	Gorakhpur	F20	Hardoi.	"
D25	Pharenda.	"	F21	Bilgram.	"
D26	Gorakhpur.	"	F22	Singhai	Bareilly
D27	Gauri Bazar.	"	F23	Aliganj.	"
D28	Sardar Nagar.	"	F24	Nighasan.	"
D29	Salampur.	"	F25	Phulbehar.	"
D30	Sagri.	Moradabad	F26	Beganj.	"
D31	Phulpur.	"	F27	Isanagar	"
D32	Azamgarh.	"	F28	Biswan.	Moradabad ¹
D33	Mohamdabad.	"	F29	Nanpara.	"
D34	Ghosi.	"	F30	Baharaich.	"
D35	Lalaganj.	"	F31	Kaisar ganj.	"
D36	Machlishahar.	Varanasi	F32	Nawabganj.	"
D37	Mariahun.	"	F33	Ramsanchi Ghat.	"
D38	Ghazipur.	"	F34	Musafir Khana.	"
D39	Mohamdabad. (Yusuf pur)	"	F35	Tarabganj.	"
D40	Ballia.	"	F36	Balrampur.	"
Category—E			F37	Utrauli.	"
E1	Kasipur.	Bareilly	F38	Bansi.	Gorakhpur
E2	State Ferry & Farm.	"	F39	Nichlaul.	"
E3	Kichha.	"	F40	Hata.	"
E4	East Pawanyan.	Moradabad	F41	Bahadurpur.	"
E5	East Mohmadi.	"	F42	Akbarpur.	Moradabad
E6	Sitapur.	"	F43	Shahgunj.	Varanasi.
Category—F			F44	Bansgaon.	Gorakhpur
F1	Dehradun.	Meerut	F45	Kara.	Allahabad (Bundelkhand! D.V. Circle)
F2	Dadri.	"	F46	Chail	"
F3	Kot.	"	F47	Phulpur.	"
F4	Baniharpur.	"	F48	Handia.	"
F5	Chachura.	"	F49	Mirzapur.	Varanasi
			F50	Mugalsarai.	"

UTTAR PRADESH (STATE TUBE WELLS)

GROUP CATEGORY	GROUP AVERAGE RUNNING HRS. PER TUBE WELL PER YEAR
A	ABOVE 4,000 HRS.
B	3,000 TO 4,000 HRS.
C	2,000 TO 3,000 HRS.
D	1,000 TO 2,000 HRS.
E	500 TO 1,000 HRS.
F	GROUPS OF TUBE WELLS WHICH CAME INTO OPERATION AFTER 31.3.1959

REFERENCES:—
STATE BOUNDARY.....
TUBE WELL CIRCLE BOUNDARY.....
GROUP (A, B, ETC.).....
BOHYTELS.....



Figure 2.1:— Showing groupwise distribution of Tube-wells, bohtels and the average groupwise yearly performance in terms of hrs. run per Tube-well (for groupwise list see the Annexure)



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2.4. Circle, Division and Group-wise Distribution.—The number of tubewells in Uttar Pradesh is now over 6,000. These are organised in 23 tubewell irrigation divisions comprising 181 groups. Circle, Division and group-wise distribution of the tubewells as on March 31, 1959 is shown in *Appendix II*.

Group-wise distribution is also shown in Figure 2.1. It also indicates the rainfall contours and the average group-wise yearly performance in terms of hours-run.

2.5. Co-ordination.—The above set-up relates to the construction and maintenance of tube-wells and distribution of tubewell water. The utilisation aspect of tubewells primarily is the responsibility of the cultivators who are advised, in the technical aspects of management of farming, by the Agriculture Department of the State. The advice tendered by the Agriculture Department at the level of the cultivators is being increasingly made available through the machinery of Community Development Blocks. The organisational problem is, therefore, one of combining into an efficient team the officials of the Engineering Department and the Agriculture Department, and the cultivators themselves. The Team, as will be discussed later, did not find enough co-ordination among the different elements, which can be helpful in maximising the benefits from the use of water from the tubewells. No doubt a high powered committee for co-ordination between the Engineering and the Agricultural Department exists at the State level. But this is not sufficient. Co-ordinative action is called for, primarily at the field level. The co-ordinative action envisaged at the state level needs to be permeated to the field level also through necessary organisational adjustments. Some suggestions towards this end have been included at the appropriate places in the text of the report.

CHAPTER—III

Financial Picture

3.1. State tubewells in Uttar Pradesh have come up in two distinct stages. These could be categorised as pre-war and post-war. Post-war period could further be broken up into First and Second Five Year Plans. A chronological list of the projects sanctioned and under sanction is given in *Appendix III*.

3.2. A reference to this chronological list will indicate that the schemes sanctioned in later years, more particularly pertaining to the Eastern Districts of the State, show a minus net revenue return. The overall financial picture of the tubewell undertakings since 1946-47 is given in Table 3.1.

TABLE 3.1

Year	Gross Receipts (Rs.)	Total working expenses (Rs.)	Net Revenue (Rs.)	Simple interest (Rs.)	Profit(+) or Loss(—) (Rs.)
1	2	3	4	5	6
1946-47	52,00,614	58,78,403	—6,77,789	8,50,764	—15,78,553
1947-48	69,62,166	67,29,427	+2,32,739	9,46,851	—7,14,112
1948-49	53,26,945	74,15,722	—20,88,777	10,42,514	—31,31,291
1949-50	89,14,673	82,82,965	+6,31,708	12,17,035	—5,85,327
1950-51	98,73,290	91,40,243	+7,33,647	14,17,571	—6,84,524
1951-52	1,18,44,833	1,17,80,283	+64,550	15,06,762	—14,42,212
1952-53	1,01,19,951	1,14,45,063	—13,25,112	20,82,977	—34,08,089
1953-54	1,08,50,823	1,13,32,306	—5,21,483	31,22,728	—36,44,265
1954-55	1,25,42,744	1,29,53,817	—4,11,073	33,96,970	—38,08,043
1955-56	1,13,56,146	1,56,37,760	—42,80,614	58,71,721	—1,01,52,535
1956-57	1,28,50,113	1,98,94,990	—70,44,877	78,66,113	—1,49,10,990
1957-58	1,33,49,586	2,40,93,998	—1,07,44,412	92,94,153	—2,00,38,565
1958-59	1,70,59,128	2,86,19,702	—1,15,60,575	1,01,22,554	—2,16,83,129

3.3. The very first tubewell project was for 1,656 tubewells. Another project was sanctioned for 600 tubewells in 1946-47. Cumulative financial picture of these 2,256 tubewells is given in Table 3.2.

TABLE 3·2

(Rs. in Lakhs)

Sl. No.	Item	Total of 1,656 wells (Rs.)	New 600 wells (Rs.)	Total for 2,256 wells or columns 3 & 4 (Rs.)
1	2	3	4	5
1.	Capital outlay	199·60	161·75	361·35
	Per well	0·1205	0·2696	0·3801
2.	Gross revenue	50·600	22·98	73·58
	Per well	0·0306	0·0326	0·0326
3.	Working expenses	39·25	22·15	61·40
	Per well	0·0327	0·037	0·0272
4.	Net revenue	11·35	0·83	12·18
	Per well	0·0069	0·0014	0·0054
	Return on capital	5·59%	0·51%	3·37%

While the return from the first project was 5·59 per cent, when combined with the project of 600 tubewells sanctioned in 1946-47, the cumulative return was reduced to 3·37 per cent.

3·4. The reasons explained by the Chief Engineer, for the decline in the percentage return and as stated in the project report for 600 tubewells of 1946-47 are reproduced below:—

“ The increase in working expenses is due to greater depth of spring level below ground and consequent greater energy charges combined with increased rate of maintenance of works and

equipment at the present inflation, and the increased capital cost resulting in increased depreciation and indirect charges, have all contributed to lowering the return on the capital to this low figure. No increase in irrigation charges has been assumed."

3.5. If interest charges are also reckoned as items of expenditure, the tubewell undertaking in Uttar Pradesh become a border line from the point of view of profitability in 1946-47. Thereafter, projects have mostly been sanctioned in full consciousness of the fact that the working expenses exceeded the gross revenue return, except in a few cases where extensions have been sought to tubewell programme as in Western districts. This will be clear from a perusal of the Financial forecast statement given in *Appendix III*.

3.6. Total investment on tubewells scheme according to the books of the Accountant General upto the end of 1957-58 stands at Rs. 27,78,40,935. On an investment of this order, a minus return of Rs. 2,00,38,565 or 7.8 per cent for the year 1957-58 is a matter of significant concern. It is obvious that every effort has to be made to increase return on investment significantly. One of the objectives of the work of the Team is to indicate practical measures to this effect.

3.7. The State authorities have adduced many reasons for the existing position of deficit revenue returns on State tubewells' scheme. Among them are the accumulated and additive interest charges on capital; the rebate of annas three per rupee being allowed since 1955 in the irrigation charges; the higher electricity rates being applied than those envisaged in the project; the inadequate electric supply leading to rostering on tubewells; the delay in acquisition of lands; the cultivators' hesitancy in building their own water channels in full length and in proper manner and an erratic and heavy rainfall during the 3 years prior to 1957-58. Besides these, there may be many other indirect causes. Some of them are undoubtedly remediable. Any delay in their remedy means continuance of an average subsidy of Rs. 2,16,83,129/5,804 = Rs. 3,736/- per tubewell, and Rs. 13.07 per acre irrigated.⁽¹⁾

3.8. Water rates on State tubewells are reckoned on the basis of 16,000 gallons per rupee. Taking into account the rebate of annas -13/- per rupee to the cultivator which has been given since 1955, this rate works out to 19,662 gallons per rupee. The rate of irrigation charges on tubewells

(1) No. of tubewells at the beginning of 1958-59 was 5,559.

No. of tubewells at the beginning of 1959-60 was 6,048.

Average No. of tubewells in operation during 1958-59 was 5,804. Amount of subsidy is loss as shown in Col. 6 of Table 3.1 for 1958-59.

run on diesel power is 11,000 gallons per rupee. If the rebate had not been allowed, the gross receipts for the year 1957-58 would have been increased by Rs. $\frac{1,33,49,586 \times 3}{13}$ = Rs. 30,80,673 and the minus return would have been made up to that extent accordingly.

3.9. Electricity charges are being debited to tubewell projects in different areas according to different scales as indicated in Table 3.3.

TABLE 3.3

Source of supply	No. of Tube- wells	Rate at which energy is supplied
(1)	(2)	(3)
1. Ganga Grid	3,200	Rs. 80 per BHP and 3.5 pies per unit (<i>vide</i> G. O. No. 2421F/XXIII-141H 1950, dated 5-8-50 and G. O. No. 384-H/33-H/1941 dated 31-3-44.
2. Sarada Grid and Mainpuri Power House	870	Rs. 100.00 per BHP & 3.5 pies per unit (No sanction of Government obtained so far by Electricity Deptt. but they are sending bills at this rate).
3. Thermal Stations in East U.P.	1,530	-/2/6 per unit subject to a minimum charge for 3,000 hours running which amounts to Rs. 5,156.00 per tubewell (No sanction of Government to this exorbitant claim has yet been obtained by Electricity Deptt. but they are sending bills at this rate).
4. Diesel Driven Power Houses or Diesel engines	400	-/3/- per unit (<i>vide</i> G.O. No 690F/XXIII 46H-51 dated 1-3-51).

The Chief Engineer contends that if the electricity charges were levied on the rates stipulated in the projects and not according to the interim (*) arrangement now in force, expenses on tubewells could have been reduced by about Rs. 29,16,255/-. Reference in this connection is invited to *Appendix IV*.

3.10. The cost of operation of a tubewell previously consisted of fixed overhead charges and recurring energy charges. The fixed overhead charges include depreciation on perishable equipment, establishment and maintenance charges and fixed electricity charges. Assuming the cost of perishable equipment like pipes, strainers, motor pump control gear etc. at Rs. 20,000/- per well at the present day rates and taking 17 years as the average life of the equipment, the depreciation charges work out to

(*) By "Interim arrangement" is meant rates fixed previously on the basis of alternative means of supply of electricity such as diesel steam stations etc. until firm hydel power is available.

Rs. 1,200/- per well. Other charges (*) also on account of electricity, establishment and maintenance are shown below:—

	Rs.
1. Depreciation	1,200
2. Establishment (including leave, pension, T.&P. per tubewell)	1,200
3. Fixed electricity charge	1,300
4. Maintenance and repair charges	500
Total	<u>4,200</u>

On this basis a tubewell will be able to meet its working expenditure, if it could on an average run for 3,200 hours a year. This is indicated in Table 3·4.

TABLE 3·4

Running Hours	Fixed overhead charges including maintenance and fixed electricity charges	Cost of energy at 3 pps per unit at 10 units per hour	Total cost	Income @ 19,692 gallons per Re.	Cost per hour in pumping per T. well	Gain(+) or Loss(—) per year	Percentage return loss (—) or Gain (+)
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	%
1	2	3	4	5	6	7	8
Nil	4,200	..	4,200	..	..	(—)4,200	(—)10·5
500	4,200	91	4,291	762	8·58	(—)3,529	(—)8·8
1,000	4,200	182	4,382	1,524	4·38	(—)2,858	(—)7·1
1,500	4,200	273	4,473	2,286	2·98	(—)2,187	(—)5·5
2,000	4,200	364	4,564	3,048	2·28	(—)1,516	(—)3·8
2,500	4,200	455	4,655	3,810	1·86	(—)845	(—)2·1
3,000	4,200	546	4,746	4,572	1·58	(—)174	(—)0·4
3,200	4,200	582	4,782	4,777	1·49	(—)5	(—)0·01
3,500	4,200	637	4,837	5,334	1·38	(+)497	(+)1·24
3,700	4,200	673	4,873	5,639	1·32	(+)766	(+)1·92
4,000	4,200	728	4,928	6,096	1·23	(+)1,168	(+)2·92
4,300	4,200	783	4,983	6,553	1·15	(+)1,570	(+)3·92
4,500	4,200	819	5,019	6,858	1·11	(+)1,839	(+)4·6
4,700	4,200	855	5,055	7,162	1·07	(+)2,107	(+)5·2
5,000	4,200	910	5,110	7,620	1·02	(+)2,510	(+)6·3

(*) Source—Chief Engineer, Irrigation Deptt., Uttar Pradesh.

3·II. If interest charges are included in the fixed overhead charges, the number of hours a tubewell will be required to run to balance its working expenses will naturally be greater. Also, from the point of view of correct cost accounting, interest charges form part of fixed overhead charges. These interest charges have been reckoned on a cost of 40,000/- per tubewell at the rate of 4 1/2%. Financial picture of tubewell operation as emerges out of this consideration is given in Table 3·5.

TABLE 3·5

Running hours	Fixed over head charges including maintenance and fixed electricity charges & interest on Rs. 40,000 @4½% Rs.	Cost of energy at 3 pies per unit at 10 units per hour Rs.	Total cost Rs.	Income at 19,692 gallons per Rupee Rs.	Cost per hour in or pumping Rs.	Gain(+) Loss(—) per T.W. per year Rs.	Percentage return. Gain (+) & Loss (—) %
1	2	3	4	5	6	7	8
Nil	6,000	..	6,000	..	..	(—)6,000	(—)15
500	6,000	91	6,091	762	12·3	(—)5,329	(—)13·32
1,000	6,000	182	6,182	1,524	6·18	(—)4,658	(—)11·64
1,500	6,000	273	6,273	2,286	4·16	(—)3,987	(—)9·97
2,000	6,000	364	6,364	3,048	3·18	(—)3,316	(—)8·29
2,500	6,000	455	6,455	3,810	2·59	(—)2,645	(—)6·61
3,000	6,000	546	6,546	4,572	2·18	(—)1,974	(—)4·93
3,200	6,000	583	6,583	4,877	2·09	(—)1,706	(—)4·26
3,500	6,000	638	6,638	5,334	1·93	(—)1,304	(—)3·26
3,700	6,000	674	6,674	5,639	1·83	(—)1,035	(—)2·57
4,000	6,000	729	6,729	6,096	1·69	(—)633	(—)1·58
4,300	6,000	783	6,783	6,553	1·57	(—)230	(—)0·575
4,500	6,000	820	6,820	6,858	1·52	(+)38	(+)0·095
4,700	6,000	856	6,856	7,162	1·46	(+)306	(+)0·765
5,000	6,000	911	6,911	7,620	1·38	(+)709	(+)1·77

According to this a tubewell can balance its running cost with the income, if it runs at least about 4,500 hours per year. For the tubewells in U.P. as a whole it may be difficult to attain this average yearly figure. In the latest estimate for 1,500 State tubewells in the Second Five Year Plan, yearly running hour per tubewell have been shown as 2,861 on'y. Even in the very first estimate for 1,656 tubewells, average yearly running hours per tubewell were assumed as 3,000 to 4,000 hours.

3·12. Uttar Pradesh authorities have also contended that the economics of tubewells should not be related only to direct revenue returns, which it provides to the State Ex-chequer. Increased production from tubewells reflects other-wise too on the general revenues of different departments of the State and Central Governments. Sugarcane cess and Central Excise income from sugar production have been cited as examples. These were levied at Rs. 5·1 per ton of cane and Rs. 25/- per ton of sugar and led to a gross revenue of about Rs. 26 crores (i.e. 4·83 + 21·23 crores) from Uttar Pradesh during the year 1957-58. Certain percentages out of such revenues to different departments of the State, may be due to increased production caused by State tubewells.

3·13. Such indirect benefits will, of course, be the outcome of any agricultural scheme, and their evaluation is beyond the purview of this study. They may eventually call for a modification of the financial criteria applied to these schemes. It is the existing deficit in revenue returns from the State tubewells in Uttar Pradesh under the current financial criteria and the measures to minimise or eliminate this deficit, which are the subject of this study.

3·14. An improvement in the financial position is possible in many ways, as enumerated below:—

- (i) Reduction in the operation cost of tubewells;
- (ii) realising greater revenues from the beneficiaries;
- (iii) increasing production by better agriculture management than heretofore, so that the beneficiaries could contribute more towards revenues; and
- (iv) removing other extraneous influences affecting operational efficiency of State tubewells.

These different aspects have been discussed in this report.

CHAPTER—IV

Planning Construction and Operation of Tubewells

4.1. Selection of any tract for tubewell irrigation is dependent on local characteristics of the area like rainfall, subsoil supplies, surface configuration, soil data and the nature of crops that could be grown with the aid of irrigation. For actual location of individual wells, water sheds and drainage lines are first marked out for entire area to be planned for. Possible sites of individual wells, thus, get indicated primarily on intersection of water sheds, the off-taking ridge lines from the point of intersections serving as alignments for distribution channels. Irrigation commands of individual wells thus get formed by the natural local drainage lines besides considerations like village boundaries, railway lines, important roads and other artificial barriers.

4.2. Siting of Tubewells.—In some tubewell groups, the Team had occasion to notice that tubewells were sited mostly along roads. This leads to a ribbon like development, which is not correct from the point of view of overall irrigational efficiency. Such developments also result in increased cost of powering, as long lengths of transmission lines have to be built, if a comprehensive plan is not worked out for the entire tract in the first instance. Irrigation needs of a block of land lying between two drainages can best be looked after, if sites for all tubewells needed for the block are decided at one time. Their actual construction can, however, be undertaken in such groups as finances permit. Such a programme of work will bring in view all possible tubewell sites in their best locations, ensure economical powering arrangements and also obviate overlapping of command.

4.3. Culturable Commanded Area.—As indicated above, the gross command of a tubewell gets defined primarily by natural considerations. Actual irrigating capacity of a tubewell, however, has a basic relation to its water output. On this consideration, in the first original project for tubewells in Western districts, the area proposed to be irrigated by a tubewell was fixed as below :—

	Acreage	Percentage of C.C.A. (1,000 acres)
Rabi	240	24
Sugarcane	125	12.5
Other Kharif	60	6.0
Total Annual	425	42.5

This presumed a culturable commanded area (C.C.A.) of 1,000 acres per tubewell. Considerable variations have since been adopted in fixing C.C.A. of tubewells. The present practice is to fix C.C.A. at 865 acres for tubewell on the average, as provided for in the current projects for construction of 1,500 tubewells in Second Five Year Plan.

The Team had, however, noticed that C.C.A. has been fixed very much in excess of this figure in some of the tubewells, particularly in the Eastern districts. Apparently, the criteria, of setting targets of irrigated figures in terms of percentage of the culturable commanded areas had led to erroneous planning. It would seem better, if the target figures of irrigation on each tubewell are worked out on the basis of the tubewell water output. That will give a more realistic picture of irrigation capability of each tubewell. A re-examination of target figures on that basis will ultimately result in better intensity of irrigation in the areas actually served and exclusion of those areas, which get indifferent or no supplies, from tubewell commands. Alternative facilities for such excluded areas could then be reasonably worked out.

4.4. Borings of Tubewells.—Borings of tubewells in the first instance were done with ordinary hand operated percussion boring sets. The diameter of bore that could be drilled with such sets was limited. The tubewells then built were mostly with agricultural strainers consisting of perforated pipes, wrapped with copper wire mesh. These were successful in coarse sands. But they do not do well, where fine grain sands are encountered, as such sands ultimately choke the openings. In certain suitable locations cavity type wells were also built. Lately with the rotary rigs, tubewell bores upto 27" diameter have been easily drilled. In these wells graded gravel packing can be provided all round slotted pipe for straining purposes. This technique, the Team gathered, made tubewells possible even in the Eastern districts of the State, where there were some geological difficulties.

4.5. Criteria for Acceptance—Tubewells had been built through different agencies in the State. The criteria for acceptance of these, therefore, varies from place to place. Tubewells commissioned in the early stages were required to deliver water at the rate of approximately $1\frac{1}{2}$ cusecs i.e., 33,000 gallons per hour with a draw down of 20 ft. to 22 ft. in order to conform to prescribed standard. This led to a discharge criterion, for an acceptable well, of about 4,000 gallons per unit of electrical energy consumed at the rate of 8.25 units per hour. Against a total head of 40 ft. including depression, the overall efficiency thus yielded was 60.5 per cent.

4.6. In later projects exceptions to these criteria were made. Greater draw downs than 22 ft. and lower discharges than $1\frac{1}{2}$ cusecs were accepted. It was understood that in some of the wells in Azamgarh district draw downs

to an extent of 50 ft. were accepted. In Ghazipur and Mainpuri divisions: some tubewells having discharge of less than 10,000 gallons per hour and involving pump lift of 115 ft. were accepted as irrigation tubewells. The Team appreciates that exceptions had to be made in such an extensive tubewell programme as in the State of Uttar Pradesh. But, it is worthwhile to be cautioned against any overdraft particularly in low water table areas. Where the sub-soil resources are not adequate, we have to draw upon them cautiously. In fact, it was gathered that there was great concern even at the highest technical level, when the tubewell scheme was first undertaken in Uttar Pradesh. Scepticism was expressed whether underground supplies will sustain withdrawal of so much water over a long period. Comparisons were made with the depletion in water table caused on account of tubewell pumping in some regions of the State of California in U.S.A. An expert committee then looked into this matter. But, they were unable to express any definite opinion then. The State authorities have, however, kept systematic watch on the behaviour of the sub-soil water table. In view of such an expansion of tubewell programme, the Team feels that stock of the situation by experts in the line should be taken (at least every decade), so that water table is not adversely affected by indiscriminate pumping at any time.

4.7. Design of Tubewells—The design technique of tubewell construction has so considerably changed with the use of slotted pipes, with gravel pack in annular space within large diameter bores, that it is now possible to drill with rotary rigs. The old practice of having standard well to a drilling depth of 300 ft. provided with about 100 ft. length of agricultural type strainer, need not, therefore, be stuck to unless local conditions, so warrant. It was observed that there is room for improvement in the gravel packing technique in so far as the size and grade of the gravel are concerned. This has, in fact, to be decided not only in relation to the slot size but also to the size of sand commonly prevailing in the strata. Gravel packing could either be graded or uniform in size. There are merits and demerits in each. But a safe practice would be to adopt uniformly graded pack.

4.8. Gravel Packing—There is also need for evolving an arrangement for satisfactory placement of gravel around the slotted tube. The present practice of dumping gravel from top needs to be discouraged. In such dumping, the gravel get distributed according to their sizes. A larger size gravel falls at a quicker pace than the smaller ones. This leads to segregation of gravel grades in horizontal layers. For a satisfactory gravel packed well, it is important to have gravel pack graded in vertical plane in such a manner that the largest size of gravels are nearest that slot tube and the smallest gravel are located touching the aquifer sands. This could be achieved in a number of ways. Firstly, a series of down pipes properly spaced could be used for the purpose. Secondly, use of hydraulically op-

erated equipment for placement of gravel pack in the annular space. And, thirdly use of annular concentric wire mesh rigs in 2 or 3 feet stages, which could be withdrawn.

4.9. Bail Plug—There is also possibility of some improvement in the design of the bail plug. The old design suited strainer type wells. The new design for gravel packed wells should provide for removal of bottom plug, so that gravel round the tube can flow down or alternatively be sucked up through the main tube. This will release the grip of the gravel pack. The tubes could thereafter be retrieved with less difficulty.

4.10. Down Pipes—In some of the completed tubewells, it was observed that down pipes had not been provided for the purpose of feeding gravel, if needed, during later running of gravel packed tubewells. It is not unusual to find that stabilisation of gravel pack is not complete even after many hours of initial development. In such cases gravel stabilises itself in due course. A sounding of gravel from time to time is, therefore, necessary. In case gravel is observed to be subsiding, fresh gravel is to be fed through the down pipes. It, therefore, seems essential to provide four down pipes in all such tubewells.

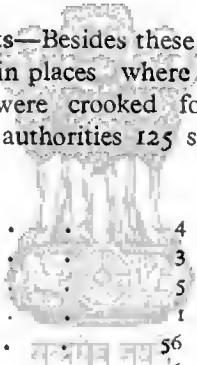
4.11. Developing Tubewells—It was also gathered that there is a tendency to make liberal use of air compressors for developing tubewells. Air compressors have to be used with great caution. Their unguarded use leads to damage the surrounding strata and consequently delays development because of the excessive removal of sand particles. Instead, it would seem advisable to develop tubewells through the technique of over-pumping. If 50 per cent more quantity of water than planned for, is pumped out a more satisfactory development normally takes place. Development by air compressors should not be resorted to as a general rule as it leads to damage the surrounding strata.

4.12. Replacement of Old Wells—Though quite a number of wells have lasted over two decades, yet according to the State authorities, the average life of a tubewell has been presumed to be between 17 and 20 years. Tubewells, when they fall below an acceptable yielding capacity of about 16,000 gallons per hour, are generally considered for reconstruction, because their running becomes uneconomic thereafter. A statement showing reconstruction done in the two old tubewell Circles, namely Meerut and Moradabad, is given in *Appendix V*. This also indicates the period after which reconstruction was needed, as also the average hours these wells had run before reconstruction. Other Circles in the State are not yet old enough. As on March 31, 1959 out of a total of 2,079 wells in the Meerut Circle only 276 needed reconstruction and in Moradabad Circle out of a total of 1,844 wells only 354 needed reconstruction. These circles are more than 25 years old. They have 12 and 62 wells respectively, which have run for more than 25 years.

4.13. It is, however, felt that before deciding upon new construction, it may be desirable to rehabilitate the well by flushing. It will be found in a number of cases that the tubewell discharge decreases because of collection of sand near the slotted pipes owing to uni-directional pumping over a number of years. Flushing helps removing such obstructions. Again, where replacement of the tubewell seems inescapable, advance action needs to be taken, so that there is no time-lag before rejection of a well and its replacment.

4.14. Equipment—In the beginning most of the tubewells were equipped with 12.5 H.P. horizontal sets. Later, where lifts of more than 45 feet were involved bore-hole-type 15 to 20 H.P. vertical pumping sets were used. In the latest project of 1,500 tubewells under Second Five Year Plan, where both strainer and gravel packed slotted type tubewells have been built, the pumping sets are of bore-hole-turbine type varying from 12.5 to 20 H.P. Abstract of cost in respect of these are given in *Appendices VI and VII.*

4.15. Submersible sets—Besides these bore-hole sets some submersible sets have been used in places where equipment is likely to be flooded or where the holes were crooked for turbine installation. As gathered from Uttar Pradesh authorities 125 submersible sets so far used are given below :—



Muzaffarnagar	4
Mecrut	3
Aligarh	5
Bulandshahar	1
Mainpuri	56
Gorakhpur	16
Basti	27
Deoria	12
Faizabad	1
Total	<u>125</u>

4.16. The operation costs of submersible sets are higher than those of ordinary turbine sets. Besides, they are not easily repairable in the country. Though the number of submersible sets is not much, yet the Team is inclined to feel that in some cases other available types of sets could be used instead. This is preferable because spare parts of other types can be had from indigenous resources.

4.17. Standardisation Needed—The Team also appreciates that in a tubewell project carried out over a long period, in piece-meal and under different types of administrative control, there is bound to be varied equipments installed. It is, however, suggested that one or two standard types of pumping sets should be evolved. These could replace the

existing sets in course of time. These standard sets should be such that they are manufactured in the country, so that their field capacity efficiency curves could be adjusted to suit the head capacity curves of individual wells. As at present, the Team feels that tubewells are fitted to the imported pumping sets, and not the pumping sets to the wells as it should rightly be. We are, therefore, unable to get maximum efficiency out of our tubewells. For such a large number of tubewell installation, any organised research conducted to standardise the design and other features of the sets, with an indigenous production bias, will go a long way in getting better performance from tubewells.

4.18. Besides pumping sets, there are many mechanical and electrical equipments like electric meters, sluice valves etc., which too need standardisation. The well kiosk and discharge tanks are masonry structures. These are built to suit local requirements and conditions.

4.19. Commissioning of Tubewells—While the State authorities had taken many steps to accelerate the rate of drilling of the tubewells, equally prompt steps do not seem to have been taken on other components that make up a tubewell. The effort, therefore, got ill co-ordinated. Time lag occurred between completion of even vital items. Energisation has been delayed in a large number of cases. A random study of 10 cases revealed that there has been a time lag of one month in 3 cases, 3 months in 4 cases and 5 to 6 months in 2 cases and more than 10 months in the other cases. This lack of proper scheduling resulted in avoidable delay in commissioning of the tubewells, thus depriving the cultivators of the much needed irrigation facilities and the Government of the financial returns. Study was also made of 46 uncompleted tubewells distributed over 16 districts as shown in *Appendix VIII*. Although arrangements for energisation had been made earlier, the tubewells themselves were not complete. This naturally meant locking up of capital, besides acting as an unhealthy drag on the pace of development of tubewell irrigation. Co-ordination of tubewell construction and power arrangements is of utmost importance. As these two aspects are controlled in Uttar Pradesh by two Departments, the Team feels that a more co-ordinated set-up should be devised so that electric power is transmitted to the tubewell as soon as the well is completed and *vice-versa*.

4.20. Water Courses—Water courses conveying the produce of well for its end-use in the fields form an important link in the chain of tubewell operation. They follow a downhill path from the tubewell, which is generally located on the intersection of the water sheds. About 1 to 1½ miles of lined water course is built for each tubewell to bring the water to the distribution points. The cultivators are expected to construct unlined channels to carry the water beyond these points to their fields. A provision is made in the estimates accordingly as indicated in abstract of cost given in *Appendix VI*.

4.21. On a number of tubewells, it was gathered that there was delay in the acquisition of lands needed for construction of water courses. Thus, tubewell water remained unutilised for a length of time. It is felt that if action is caused to expedite land acquisition and complete the water courses concurrently with the erection of tubewell, it will be advantageous both to the State and to the cultivators.

4.22. Co-operatives or Committees for Maintenance.—Maintenance of water courses is a big responsibility. As it is, it can be discharged efficiently only through the fullest co-operation on the part of the cultivators. The maintenance involves a number of items like repairing, bank erosion caused during rains, filling rat holes, stopping channel leakages and heightening over-top banks, removing accumulation of sediments from the floor of the channels and clearing vegetation. In a spread out net work of water courses, improved standards of maintenance particularly of unlined portions could be expected only if the beneficiaries are encouraged by Block Development Committees and *Panchayats*, to form Co-operatives or Committees for such maintenance works.

4.23. Compaction of Filling Reaches.—It was observed that at some places earth for repairs had been burrowed from the pits made in the nearby fields. If the burrowed areas are properly demarcated for the purpose, even if some lead may be involved in the earth work the culturable land is saved to the best possible extent for production of food. In fact, the Team feels that alignment of these channels should be carried out in such a manner that heavy embankments are avoided as far as possible. Whenever embankments have to be constructed, it would be desirable that the filling portion is well compacted in accordance with the optimum moisture requirements and other scientific considerations, instead of leaving the compaction to rainfall alone.

4.24. Looking to the losses by evaporation and percolation occurring on unlined channels, it is felt that extension of *pucca* channels will be more desirable on the tube-wells. It was gathered that the State authorities have already sanctioned in March, 1959 a project costing Rs. 2.06 crores for extension and improvement of water channels. This work is to proceed as funds become available, but the significance of the work and its impact on irrigational programme of tubewells is so great, that no amount of attention given to water courses could be considered too much.

4.25. Appurtenant Works.—Many tubewells in the State are equipped with tanks and outlets for rural water supply. The tanks are designed to furnish sanitary drinking water to the nearby villages. In small villages where the demand is low, a tank for 1,000 to 2,000 gallons is provided. If the demand is heavy, the tank is constructed on a tower. The use of tubewell water for drinking purposes is made extensively on certain tubewells, but in many cases, it wa

observed that use is not made of the facilities provided. Apparently, the facility is not within convenient distance of the user. It would, therefore, seem advisable, if they are provided only after careful consideration of the users' convenience. A general watch over these is kept by the tubewell operator, whose house is located close by. The operator's house consists of one room with a covered varandah. The access roads to the tubewells are of simple design. Crossings for channels over these roads are provided generally with pipes. They, when needed, serve as drainage outlets also.

4.26. An Act to provide for the construction, improvement and maintenance of state Tubewell irrigation works, passed by the legislative council of the United Provinces of Agra and Oudh is given in *Appendix IX*.



CHAPTER—V

Performance of State Tubewells

5.1. A statement showing the overall group-wise performance of tubewells in the 23 divisions (in respect of wells, which were in operation on March 31, 1959) is given in *Appendix II* and Figure 5.1. This shows areas irrigated per well, average running hours per well and average assessment per well. Individual study of wells was not possible, as their number exceeded 6,000. It was felt that collective group and division-wise study would be fairly indicative of the trends.

5.2. **Regional Variations.**—According to the overall State figures supplied for 24 years *i.e.* from 1936-37 to 1959-60 as per Table 1.1, tubewells have generally run on the average for the required minimum of 3,700 hours only during 4 years. However, in 1959-60 the latest year for which data were collected the average worked out to 2,250 hours. As these averages do not reflect the marked difference in the performance of State tubewells in the widely divergent regions, performance in representative groups in the three regions, *i.e.* Western, Central and Eastern, was studied. A study of these representative groups for the year 1959-60 is given in Table 5.1.

TABLE 5.1
Performance of tubewells of 10 years' standing and more.

Serial No.	Name of group	No. of tubewells.	Average irrigated area (in acres) per tubewell	Average running hours per tubewell
(1)	(2)	(3)	(4)	(5)
<i>Western Region</i>				
1	Ghaziabad	24	585	5,084
2	Hapur	113	494	4,122
3	Roorkee	42	262	1,642
4	West Khair	26	365	2,704
5	Total	205	1,706	13,612
6	Average	51	427	3,403
<i>Central Region</i>				
1	Farrukhabad	36	308	3,288
2	Amroha	91	300	3,016
3	Aonla	64	202	2,020

(1)	(2)	(3)	(4)	(5)
4	Sirsi	108	393	3,936
5	West Mohamadi	69	414	3,050
6	Total	368	1,617	15,310
7	Average	74	323	3,062
<i>Eastern Region</i>				
1	Gorakhpur	41	279	2,215
2	Deoria	53	362	3,234
3	South Varanasi	54	325	2,627
4	Jaunpur	18	216	2,146
5	Rasra	43	371	2,823
6	Total	209	1,553	13,045
7	Average	42	311	2,609

This will indicate that the average running hours in the Western region came to 3,403 hours, in the Central region to 3,062 hours and in the Eastern region to only 2,609 hours per tubewell.

5.3. Interpreting the above performance in the light of operation schedule provided in Chapter III, tubewells in the Western region are able to run as many hours as are required to cover their working cost. Tubewells in Central and Eastern regions did not work up to that level.

5.4. Table 5.1 also indicates that the area of irrigation per tubewell diminishes from West to East being 427 acres in the West, 320 acres in the Central region and 311 acres in the Eastern region. Apparently, tubewells in the Eastern region are not as good as those in the Western region even after passing their development stage (of three years). Since the number of tubewells in the Eastern and Central parts of the State is about 50 per cent of the total, it is obvious that the performance picture of tubewells in the State, taken as a whole, will be a matter of concern until vigorous steps are taken in the respective regions to develop irrigation on tubewell commands.

5.5. **Maximum and Minimum Performances.**—Among the 23 irrigation divisions the maximum area irrigated was 501 acres in Muzaffarnagar which has 283 tubewells. The lowest average irrigated area of 58 acres on the other hand was recorded in Tarai tract in Barilly division, where the tubewells are only 14 in number and cannot be considered as a representative group. Among tubewell divisions with lesser number of running hours than needed, is Shahjahanpur which has 269 tubewells and irrigated 198 acres only per tubewell.

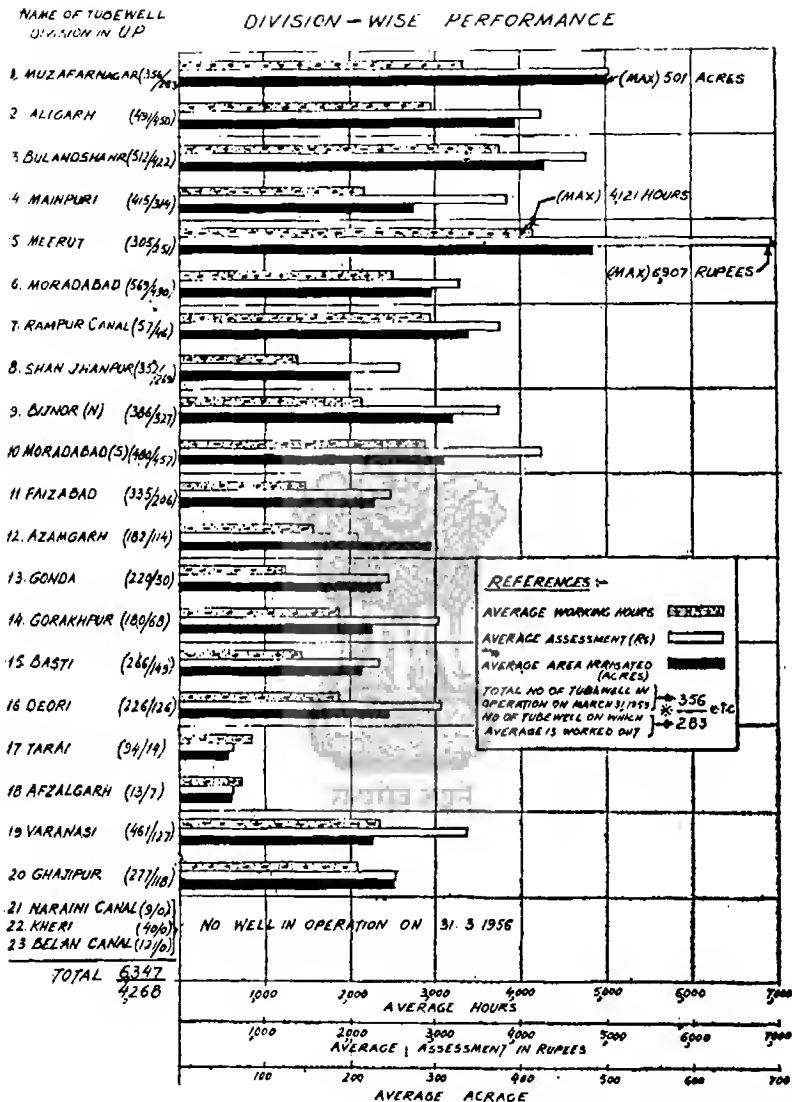


FIGURE 5.1 : Graph on performance of the Tubewells in different Divisions of Uttar Pradesh showing average hours, average assessment and average area irrigated per tubewell in operation on March 31, 1956. This is based on Figures in respect of ten years average as per Appendix II.

Numerator { Total No. of Tubewells in operation on March 31, 1959.

Denominator { No. of Tubewells on which average is worked out.

5.6. In a preliminary study, the Team analysed the performance of tubewells on the basis of data received for three consecutive years namely 1955-56, 1956-57 and 1957-58. Pertinent observations from that analysis are given in *Appendix I*. The State representatives, however, thought that during the three years under review more than 50 per cent of the tubewells were in development stage *i.e.* under three years of age. Besides, the period coincided with a wet seasonal cycle. According to them, examination of three latest years did not reflect a correct picture of tubewells' development. They contended that at least 10 years data should be looked into. The Team agreed that data, on this basis, may also be presented and the results of both should be compared. The picture of overall performance in the State as a whole, however, remained materially the same. We have to go a long way, before we can reconsider the State tubewells as units of fully developed irrigated agriculture and of a financially self supporting scheme.

5.7. **Incidence of Yearly Rainfall.**—The varying performance of tubewells is undoubtedly influenced by the incidence of yearly rainfall in different areas. Heavy rainfall in September or October causes reduction in the running hours of the tubewell in the following *Rabi* seasons as well as in the area irrigated. Likewise even an inch of rainfall during December or January adversely affects the running of tubewells. A graphic study of tubewells constructed during the same year and situated in the regions of same rainfall pattern has been made in a number of cases. These studies have been conducted in respect of bad cases, as also good cases in order to provide a more objective analysis of their comparative performance. They include 14 representative groups, 4 from Western districts, 5 from Central region and five from Eastern districts. The graphs are given in *Appendix X*. They have been drawn according to following four categories.

Plotting No. 1 shows the total rainfall received in each Tehsil headquarters in which the tubewell group is situated.

Plotting No. 2 shows the percentage variation of rainfall from normal in the third quarters during October to December and in the fourth quarters during January to March each year at the Tehsil headquarters in which the tubewell group is situated.

Plotting No. 3 shows the average running hours every year in respect of tubewells brought into commission in the same year *i.e.* tubewells of the same age.

Plotting No. 4 shows the average area irrigated per tubewell every year in respect of tubewells brought into commission in the same year *i.e.* tubewells of the same age.

These graphs illustrate that incidence of rainfall during the 3rd and 4th quarters considerably affect running hours as well as area irrigated by a tubewell.

5.8. Incentives.—With a view to extending the use of tubewell water and ensuring the fullest possible utilisation of a source that has been created at a great cost, many changes in the operation of tubewells seem necessary. Some of these are enumerated below:—

(a) A two-part tariff may be introduced consisting of:—

- (i) a standing fixed annual acreage charge on the area included in the command of the tubewell and
- (ii) a recurring variable charge billed according to the volume of water used.

The result will be that the variable charge based on the volume of water utilised will come down. Once the cultivator has to pay the fixed standing annual acreage charge, he will have incentive to make a greater use of water, particularly as the charge for it will have been lowered. Consequently, running hours of wells may rise.

(b) Tubewells in future should be situated only in those areas, where cultivators give prior undertaking to pay standing charges for their respective holdings. Till such an undertaking is given by a reasonable number of cultivators, no tubewell should be built. Where irrigation of area is really needed, such an undertaking should be forthcoming.

(c) As an incentive for using tubewell water it may be advantageous to introduce different rates during active and slack periods. Lower rates will act as an incentive for using tubewell water during the slack period. This may facilitate operation of *Warabandi* and *Osrabandi*. Rules thereabout could be modified as necessary. Also, this will go to spread out the demand over a longer period.

(d) Further, where tubewells are not running to their capacity, water rates may be reduced for a limited period for special types of crops. That will familiarise the cultivator with the use of tubewell water. The reduction should, therefore, be only for a limited period.

5.9. Osrabandi (Warabandi).—It was observed that under the existing *Osrabandi* system time limit for the supply of water to a cultivator is set according to area in the command rather than his effective demand for water. The turn of each cultivator belonging to a particular group, thus comes generally in a fixed rotation of 14 days. *Osrabandi* Rules are given in *Appendix XI*. Whenever there is closure of tubewell due to mechanical or other defects the *Thok* during whose turn the well remained closed would lose its turn without affecting the turn of the next *Thok*. The team appreciates the difficulties in practical implementation of such rules. It is not

easy to satisfy all interests at the same time. The drawbacks in the existing system, however, need consideration. Difficulties now faced by the users of tubewell water could be removed to some extent through the good offices of *Panchayats* and the Block Development Committees. On the whole, the Team feels that the rules are too rigid as they preclude possibilities of utilisation of water more frequently than what the cultivators do according to the laid down roster. *Osrabandi* rules may be made more flexible and adjustable, so as to allow liberty for exchange of turns and similar other measures.

5.10. Economy in the Use of Water.—The Team during their field studies observed that the cultivators were using far greater amount of water per irrigation than what was actually required. This may be partly due to the fact that so far the cultivators were accustomed to irrigate their fields from open canals where assessment is done on acreage basis and where supplies are not readily available on demand as on tubewells. It was also due to the fact that full supply of tubewell water, amounting to one to two cusecs, was allowed to run out of a single outlet, thereby forcing the cultivators to have fields of abnormally large size. The fields in some cases were found as big as $1\frac{1}{2}$ acre and the depth of water supply per irrigation aggregated to 6" to 7" or more. Excessive use of water is not only wasteful but is also harmful to crop. As an example, we may point out here the experimental work done at Nasirpur Farm near Patiala under the I.C.A.R. to determine the optimum quantity of water required and the depth to be applied for each watering to wheat crop. These experiments were conducted with 2, 3, 4 and 5 inches deep irrigation and their comparative benefits were recorded. They showed that while there was an insignificantly slight benefit in favour of 3-inch irrigation as against 2-inch irrigation, there was absolutely no difference between 3-inch and 4-inch irrigation. 4-inch irrigation, therefore, was mere waste of water. 5-inch irrigation, proved to be not only wasteful, but actually decreased the crop yield. Still another very interesting experiment, conducted at Govt. Sugarcane Farm, Ankapalle, showed that irrigation of even $1\frac{1}{2}$ -inch depth in the field, for sugarcane crop had proved most remunerative. The significance of these results requires to be fully appreciated in tubewell irrigation, where water is costly item and economy in its use is urgently called for.

5.11. Measures to Improve Performance.—The overall performance of tubewells also suffers for want of good distribution of supplies within the fields themselves.

Firstly, water is allowed in quantities larger than necessary at one or two points in a field leading to erosion and flooding. It would seem advantageous, if water is allowed into the fields at many points so as to enable uniform distribution of supplies over the entire area.

Secondly, the existing field distribution links are low capacity channels designed to suit persian wheels or other low capacity methods of irrigation. These internal distribution channels have to be modified to take high discharges of tubewells.

Thirdly, the fields are not levelled adequately. Unless fields receive proper land preparation, tubewell water is likely to be wasted. In fact, proper levelling of farm lands should be a pre-requisite to introduction of tubewell irrigation. Wherever necessary loans should be advanced to affected cultivators. Levelling may also be done through a State managed agency, on a cost-recovery basis, if levelling cannot be done by cultivators themselves.

Fourthly, in certain areas there has been disproportionate expansion in areas under crops with high water requirements like sugarcane. This eventually leads to inequitable distribution of supplies and uneconomic overall utilisation thereof. There is, therefore, a need for fixing and enforcing a suitable crop pattern based on water requirements of crops on the one hand and actual availability of water from each tubewell on the other. For this purpose officers may have to be endowed with special powers to be exercised in collaboration with the local administration. Also, varying tariff for different crops may indirectly help to bring about the desired crop pattern.

Fifthly, the State Government may set up a research wing to draw upon the experience on tubewells including ground water studies conducted at Irrigation Research Institute, Roorkee. Benefits of research may be made available to all concerned so that the general tone of irrigated agriculture improves in the areas served by tubewells.

5.12. Education in Better Farm Methods.—Cultivators in the command of Tubewells should be encouraged to use modern ploughs and scientific instruments to determine the depth of irrigation required. This will obviate over-irrigation, as also unnecessary irrigation. The Team feels that there is no consciousness about these very important factors governing irrigated agriculture among cultivators even in tubewell project areas. With the costly irrigation system that the tubewells provide, it would be advisable if pamphlets on proper timing of irrigation and on other connected aspects of irrigated agriculture are widely distributed in tubewell areas preferably written in local language and phraseology. In addition, it would also be desirable to demonstrate improved techniques to the cultivators on their fields. An effective irrigation expansion drive should be introduced through Community Development and Village Panchayat Organisations, which should aim at better farm management and improvement of the existing agricultural practices. In fact, these local bodies must formulate schemes for each individual State tubewell. This is necessary because conditions of all the State tubewells in respect of their develop-

ment are not the same. Only when the precise needs of each individual tubewell are determined after survey of each tubewell area, can a development scheme be formulated effectively.

5.13. Preparedness.—To get the maximum benefits out of the tubewell both by way of increased gain to the cultivator and better returns to the State, it is essential to accelerate the activities on the agricultural development side in tubewell areas. It is felt that a cell of agricultural staff if created in the Irrigation Department¹ to deal specifically with tubewell project areas, objectively aiming at a field programme of scientifically planned preparedness, it will considerably accelerate the otherwise routine action. A note drawn up by the Team on pre-planning aspect of the problems in consultation with Director of Agriculture, Uttar Pradesh is given as an Annexure to Chapter VI. This cell should in fact, be created in advance of tubewell drilling operations, so that the areas get agriculturally prepared, before tubewells go into operation.

It will also be advantageous if preference is given to agriculturally trained persons in recruitment to the post of tubewell operators and revenue staff. Other staff also may be given orientation courses in agricultural practices so that they may be better equipped to devote their spare time to the needs of irrigated agriculture.

5.14. The general picture of tubewell operation and performance, as presented above, will not be complete unless mention is made of certain special cases also, like the tubewells in Hastinapur Group and those built by Co-operatives and of private tubewells operating in the State.

5.15. Hastinapur Group.—Hastinapur group comprises of 23 tubewells situated in Ganga-Khadar region about 23 miles from Meerut. They were built at a cost of Rs. 5 lakhs for colonisation of refugees and not under a State tubewell project. The State Irrigation Department had nothing to do in their planning or in their construction. The spring level in this area is high. The cultivators find it more profitable to sink open wells and fit them with pumping sets. Had the advice of the Irrigation Department, which has an experience of more than 25 years in the line, been obtained by the Rehabilitation authorities this project would have been planned differently. The State authorities may, therefore, examine the possibilities of retrieving as much material as possible, leaving the tubewells running at present with Mechanised State farm.

5.16. Co-operative Tubewells.—Besides State tubewells there are 590 co-operative tubewells, particularly in Meerut and Moradabad regions. Out of these wells 124 are now proposed to be handed over to the Irrigation Department at a cost of about Rs. 65 lakhs. Originally they were under Co-operative Cane Growers Federation, Uttar Pradesh and other Co-operative Societies. Only a few are said to be working satisfactorily.

Others are being extracted. Their failure may be due to the fact that they were run on diesel engines which are too expensive. Besides their management too was lacking in efficiency. It would be worthwhile to make a study, as to how best these tubewells could be made serviceable to the cultivators of the area, instead of being extracted. May be, their conversion to electric driven system will make them more workable than what they are at present. The Team feels that the State government may take interest in these wells, so that they may be utilised to the best advantage of the area, probably with lower capacity pumping units and smaller commands.

5.17. Private Tubewells.—The Team also came across a number of private tubewells. It was gathered that on some of these wells the owners were getting higher yield of sugarcane crops than those on the State tubewells and were using water more economically due to smaller sizes of their fields. There were no authentic figures of production that could be examined. Apparently, greater individual interest and better water management lead to better irrigation efficiency and ultimately to better yields. The State authorities, on the other hand, contend that some of the private owners take water from State tubewells to supplement their own supplies. According to State authorities, if one or two progressive cultivators grow more food through better land and water management and through application of artificial fertilizers, they make exceptional cases. Their comparison with State tubewells, which have to cater to cultivators in general is, therefore, not always possible. While accepting this view, the Team feels that incentives should be devised to improve the overall production capacity of state tubewells, which provide an irrigation resource so readily available and so plentiful.

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CHAPTER—VI

Agricultural Aspects of Tubewell Irrigation

6.1. Increased Yield the only Criterion of Success.—The organisation and functioning of State Tubewells have to be viewed, in the ultimate analysis, in the perspective of “*increased agricultural production*”. Providing an adequate supply of water for irrigation is not “an end in itself” but only a “means”, intended to augment the production of crops. The capacity of the farmers to project their effective demand for tubewell water depends upon their purchasing power, which in turn, depends upon increased returns from high yields of crops. But, increased yields cannot be obtained by irrigation alone. Irrigation can yield best results only if it is accompanied by other factors such as suitable change in the cropping pattern, improving and maintaining the fertility of soil, use of improved varieties of crops, application of artificial fertilisers and green manuring, adoption of plant protection measures and improved cultural practices.

Normally, with the change over from dry to wet farming radical changes are called for in the crop pattern and in agricultural practices in the project area. Stepping up the crop yields, therefore, forms the focal point upon which all efforts should converge. Substantial and sustained efforts did not, however, appear to have been made to bring about the desired transformation. Some of the important factors which, accompanied by irrigation water, generally contribute towards the high yield of crops but which appear to have received inadequate attention in tubewell areas are discussed in this chapter.

6.2. Change in Crop Pattern.—Prior to the installation of tubewells, mostly rainfed crops like *Bajra*, *Jowar*, *Moong* and *Moth* were sown during *Kharif* and Barley, Gram and *Bijli* (Mixed) during *Rabi*. Some area on persian wheels also used to be put under wheat and sugarcane crops. With the installation of tubewells, no doubt there has been some change in the cropping pattern and cash crops like Potatoes, Peas and Green fodders have been introduced, and area under sugarcane and wheat crops has also been extended. Increase in the area under sugarcane has, however, been mostly governed by the location of sugar factories in these areas, particularly in the Western part of the State. Similarly in the Eastern part, wherever sugar factories have come into existence, there has been some extension in the area under sugarcane. But in areas where sugar factories.

have not been set up and transport facilities were also non-existent, there has not been any marked change in the original crop pattern, inspite of the fact that there existed vast scope for the introduction of crops like Maize, Groundnut, early Paddy and Potatoes. Early summer vegetables and fodders could also be taken up in areas of easy accessibility to the market to stimulate demand for tubewell water, specially during the lean periods which usually fall in early summer.

6.3. Improved Seeds—It is an accepted principle that different crops, in fact different varieties of even the same crop, have varying response to irrigation water. Accordingly, for different regions and even for different areas in the same region, different varieties of crops are recommended by the State Agriculture Departments. For instance, in Punjab, C 518 wheat is recommended for rich lands with plenty of water and manure, C 591 wheat for average soils under average irrigated conditions and C 281 wheat for late sowings and rainfed conditions. Under similar conditions *i.e.*, other things being equal, the difference in crop yields, on account of varietal factor alone, may be of the order of several maunds per acre.

- (a) In Uttar Pradesh, although a few improved strains like C 591 (Punjab Variety) in the Western part and N. P. 710 (IARI) in the Eastern part are being recommended by the State Agriculture Department, yet not many "different purpose varieties" have been evolved or are being recommended to suit varying conditions of soil, sowing time and water requirements *etc.* At any rate, in the areas under tubewells visited by the Team, there was little awareness on the part of the cultivators about the suitability of different strains for different irrigated conditions and different sowing times.
- (b) Even in the case of a few improved varieties recommended by the State Agriculture Department, their use was confined only to a limited number of progressive cultivators. The cultivators at large were not sufficiently influenced in this direction.
- (c) In regard to the distribution of improved seeds, no doubt, some arrangements have been made through seed depots and co-operative stores in the villages, but in the absence of adequate "Follow-up" and timely replenishment, the quality of seeds of the few improved strains had tended to deteriorate. Cultivators were not always raising improved seeds for their requirements and mainly depended upon Agriculture Department and other extraneous agencies for this purpose.

6.4. Maintaining Soil Fertility.—Apart from the use of improved seeds, judicious application of manures and fertilisers is not only an important factor in increasing the crop yields, but irrigation also can yield best results only when soil fertility is improved and maintained at high level:

Since farm yard manure is not available in adequate quantity with each farmer and composting of refuse material is also not widely practiced, all the crops can not obviously receive enough manuring. In order to augment the supply of farm manure for maintaining soil fertility, the cultivators, are generally advised the use of artificial fertilisers. Here again, it was noticed by the Team that the use of artificial fertilisers was confined largely, if not entirely, to cash crops like Potatoes and Sugarcane in the 'cane belt' areas, mainly under the aegis of the State Cane Development Department. Wheat and other important food crops did not receive much artificial fertilisers worth mentioning, due perhaps to the fact that the usefulness of artificial fertilisers, and their economics, had not been demonstrably brought home to the cultivators.

6.5. Green Manuring.—Even if the artificial fertilisers could not be expected to be extensively used, both on account of their limited supply inadequate publicity amongst the average cultivators about their usefulness, the farmers could certainly adopt green manuring practice, which offers tremendous scope for raising the soil fertility. But it was noticed that the practice of green manuring was confined to very few progressive cultivators, and that also, in the case of sugarcane crop with *Moong* Type I or *Lobia*. The usual practice of sowing *San* or *Guar*, so much prevalent in Punjab and *Glyricidia* etc. in the South, which provide abundant supply of vegetative matter in the soil, was not noticed by the Team. This may be due to (a) the lack of conviction on the part of cultivators about the usefulness of green manuring as an effective method to improve the fertility of soil and accordingly to increase the crop yield or (b) reluctance on the part of farmers to pay the same water charges for green manure crops as levied on normal crops.

6.6. Layout of Demonstration.—Although usefulness of demonstration plots as a method of convincing the farmers about the superiority of improved varieties of crops or benefits of application of fertilisers, or certain cultural practices, is commonly acknowledged, yet these demonstrations, become almost indispensable in the tubewell areas, both in the interest of cultivators and the Irrigation Department, if maximum advantage of Tubewell Irrigation is to be derived. Out of about 40 State tubewells visited at random by the Team, demonstration plots were laid out hardly on two tubewells by Block Officials, and that too, on Japanese methods of paddy cultivation only under the *Kharif* campaign organised by the State at that time. The Agriculture Department was obviously not able to give adequate attention to this work for lack of staff and finances. Still worse was the fact that a great deal of the time of even the normal agricultural staff provided at the District and Block Headquarters, was spent in ever increasing office work, necessitated by endless enquiries both from the Centre and the State Headquarters at the expense of demonstration and other extension work.

6.7. Plant Protection Measures.—Even if all factors responsible for increasing production are attended to, inadequate attention towards plant diseases and insect pests can nullify all the efforts directed towards increasing crop yields. During field visits, the Team was informed by the cultivators that during the last three to four years, sugarcane borer, wheat smut, potato blight, gram wilt, and other crop pests and diseases had seriously affected their crops. But to undertake plant protection measures in the affected areas, necessary equipment and technical know-how could not be made available to them by the authorities concerned. According to the Agriculture Department, not even one plant protection unit has been provided for each District and evidently it was not easy to cover large areas with such inadequate staff.

Even at the Block sub-centres, although some plant protection equipment and insecticides and fungicides in small quantity have been provided for use by the Village Level Workers, but even these officials, available right on the spot in the villages, could not undertake timely and effective control-measures on account of their other alleged pre-occupations in arranging supplies and providing “Works amenities” in the village. Dual control also was not conducive to the maximum utilisation of the limited staff and material.

6.8. Tubewell Department Scheme.—In the beginning of the Tubewell projects, wherever Tubewells were installed, an Agricultural Department Scheme (called the State Tubewell Development Scheme) used to be sanctioned for that area but this practice lasted up to year 1948 only. As a result of these schemes, according to the reports of Agriculture and Irrigation Departments and the cultivators, much useful work has been done in the areas covered under these schemes. But it has to be remembered that during that period *i.e.* upto year 1948, the tubewells were in their formative stages and numbered hardly 2,000 in the whole State. It was, however, only in the later stages (by March 1959, the number of tubewells installed had increased to about 5,900) when the full benefits or usefulness of State Tubewell Development Schemes could have been greatly realized and their impact largely felt under conditions of extensive irrigation. No wonder that, in the absence of such organised and beneficial schemes, progress in the development of Tubewell areas both from the viewpoint of greater use of water and increased agricultural production, has been arrested and no great advantage is being taken of the irrigation facilities made available to farmers at such a heavy cost.

Annexure to Chapter VI

PRE-PLANNING FOR EARLY DEVELOPMENT AND SUCCESSFUL RUNNING OF TUBEWELLS.

A note prepared jointly by the Director of Agriculture (U.P.) and Member minor irrigation Team on March, 27, 1960

In order that the tubewells installed by Government may run successfully and their full potential developed within as short a period as possible, it is necessary to prepare the ground before the project is actually taken up. The following suggestions are given in this connection :—

- (a) As a general rule, open wells, bored if necessary for increasing supply of water in the wells, fitted with Persian wheels or pumping sets worked by bullock power or engines or electric motors should be given preference over the expensive types of tubewells in areas of high rainfall and shallow sub-soil water level, in as far as, initial expenses are not too high and what is most important, it gives freedom to the cultivators to draw any amount of water at any time for any length of period to suit his crop requirement and he can utilise his bullock power in season when irrigation is badly required but bullocks are idle. This is possible only if wells are fitted with Persian wheels or even new types of bullock driven pumps. For this purpose liberal loans with some subsidy, if necessary, should be given.
- (b) State tubewells should be sunk *only after* the cultivators in any area have been sounded on this matter and the agreement of majority of them to pay certain minimum irrigation cess per acre obtained in advance. For obvious reasons, it is easy and practicable to secure such commitments *before* the tubewells are sunk but it becomes difficult, if not impracticable, to secure such undertaking *after* the tubewells are actually installed. Once the tubewells are sunk they cannot be easily removed even if cultivators refuse to give any undertaking.
- (c) After the commitment of people for payment of irrigation cess is obtained, then simultaneously with the boring of tubewells, the work of layout of water courses, acquiring lands etc. should be started so that all preliminary work is fully done and completed by the time the tubewells begin to function. Actual construction of the channels can be taken up after the success of a bore is ascertained.

- (d) While the tubewells are under construction, lands coming under irrigation should be properly surveyed particularly in regard to levelling of lands to facilitate efficient and economic irrigation. In case of uneven lands "*taccavi*" should be given to cultivators for levelling lands. This will help in greater and more economical use of water for irrigation.
- (e) Since different varieties of even the *same* crop vary greatly in their water requirement—some requiring heavy irrigation and others, light, some requiring rich soils and others able to grow in relatively poor soils—and varieties grown under conditions of dry or *Barani* cultivation may not necessarily be suitable under irrigated conditions and since the time of sowing, seed rate and even other cultural practices, in fact the whole crop pattern is greatly different under different conditions, it should be the duty of the State Agriculture Department to carry out experiments on above problems, well in advance in areas coming under irrigation so that, with the advent of irrigation facilities, the cultivators can be properly guided in the most economical and efficient use of water for securing best results in crops. This can be done with the help of open wells already existing in the area, or if necessary, even by sinking new open wells. Such experiments are far more important in tubewell areas than in canal areas because of much higher cost of tubewell water and need for the greatest economy in the same.
- (f) Since supply of irrigation water is only 'Means to an end' the end being to improve the productivity of land which is the function of the Agriculture Department, there is need for greater liaison between the two departments. Accordingly the Agriculture Department should be closely associated with the formation and execution of all tubewell projects, *i.e.*, siting of tubewells, crop patterns to be encouraged, C.C.A. for each tubewell to be fixed, *Thok bandi*, water distribution, formulation of rules relating to the most economical and efficient use of water or irrigation requirements of crops, limitation of area under certain crops at each tubewell, if necessary, or grant of *Taccavi* for levelling lands or construction of water courses or formulation of rules or concessions in connection with green manuring *etc.* The two local officers of Agriculture and Irrigation Departments, along with the local officer of planning, should form a local committee for the planning and execution of the whole scheme.
- (g) As far as possible consolidation of holdings should precede the construction of tubewells which would lead to the most economic and efficient use of water.

- (h) A proper scheme for the development of State tubewells like the one which existed in Uttar Pradesh some time ago, when the first tubewells in the western districts were sunk, should be launched again in close co-operation of Agriculture and Irrigation Departments.
- (i) It may be necessary to fix different rates of charges for different crops—cash crops being charged higher rates than food crops. Likewise, it may be necessary to subsidise the irrigation of green manure crops in order to build up the fertility of the soil.



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SUMMING-UP AND RECOMMENDATIONS

The question of construction, maintenance and operation of State tubewells in Uttar Pradesh and their financial remunerativeness, is of great complexity. In it are implicated many disciplines of science and many aspects of humanity, namely, geology, sub-soil water resources, natural precipitation and its variations, hydrology, engineering, sources of energy, mechanical equipment and their indigenous production, utilisation of water supplies, agronomic practices and their traditional background, agricultural statistics, revenue returns, financial analysis of overall and indirect benefits, State and private interests, frame-work of communal and social life, State taxation policies, betterment levies, co-operative trends, general economic development and above all, the urge of a welfare State to raise its production level and standard of living of its people. The team has, therefore, looked into the question from a broad-based view and minor points indicating short-falls and shortcomings, which came under observation during individual case studies, have not been included in this report. They were, however, discussed with the officers concerned and State authorities will undoubtedly take action to remedy those. Matters involving policy decisions and of wide interest have mostly been taken up and recommendations of the Team are given below:—

- I. A co-ordinated approach for development of tubewell areas as envisaged at State level should be extended to Community Development Block and village levels. (*Para 2.5*)
- II. An expert scientific and detailed evaluation of direct and indirect benefits accruing from tubewell schemes should be made in order to examine whether it is necessary to have modified financial criteria to judge tubewell performance. (*Para 3.13*)
- III. Minus returns faced by the State should be made up through improvement of operational efficiency, increase in production by better agricultural management than heretofore and consequently in revenue returns. (*Paras 3.12 and 3.13*)
- IV. The siting of tubewells in ribbon like fashion along main roads should be avoided as it involves costly energisation due to long lengths of transmission lines. (*Para 4.2*)
- V. Unnecessarily large commands on tubewells should be reduced so that areas not adequately served by such tubewells could be developed through alternative means or additional tubewells. (*Para 4.3*)

- VI. A periodical stock-taking of sub-soil water resources should be made in respect of areas served by tubewells, say every ten years. (*Para 4.6*)
- VII. Where rebuilding of tubewells involves closure of irrigation service, advance action should be taken so that damage to crops and inconvenience to cultivators are obviated. (*Para 4.12*)
- VIII. Standard types of equipment, that can be manufactured within the country, should be evolved to replace the present diverse makes when they wear out. (*Para 4.17*)
- IX. Community Development Block Committees and Panchayats should encourage cultivators to form co-operatives or Committees for the purpose of maintaining water channels on tubewell commands. (*Para 4.22*)
- X. Earth work formation on water channels should be scientifically compacted on optimum moisture content basis. It should not be left for natural consolidation by rainfall alone. (*Para 4.23*)
- XI. With a view to minimising percolation losses, lining of channels should be done, as far as possible. (*Para 4.24*).
- XII. (i) A policy of taking prior undertaking from intending irrigators from State tubewells should be adopted. [*Para 5.8(a)*]
 (ii) A Two Part Tariff consisting of a fixed standing charge and a variable recurring charge may be introduced. [*Para 5.8(b)*]
 (iii) Different water rates during slack and active periods should be introduced so as to encourage cultivators to use tubewell supplies. [*Para 5.8 (c)*]
 (iv) Where tubewells are not running to their capacity, waterings at reduced rates should be allowed for special types of crops. [*Paras 5.8 (d) and 6.5*]
- XIII. *Osrabandi warabandi* i.e. water distribution rules should be made more flexible and adjustable. Clause giving option to change turns could, with advantage, be introduced. (*Para 5.9*)
- XIV. As application of irrigation water in shallow depths at suitable intervals is beneficial to crops, inducive measures should be devised to encourage cultivators to do so. (*Para 5.10*)
- XV (i) Areas under high water requirement crops should be limited on each tubewell so as to ensure adequate supply of water to all holdings. (*Para 5.11*)

- (ii) Levelling of fields being a pre-requisite of wet land farming it may be undertaken by the State Government on a cost basis, the cost being recoverable from cultivators in easy instalments. The State Government may alternatively advance loans to the affected cultivators and offer technical assistance, if needed for the purpose. (*Para 5.11*)
 - (iii) The State Government should set up a Research Wing to draw upon the experiences and results achieved on demonstration or model farms and on well bores and equipment performance, including the Ground Water Studies conducted at the Irrigation Research Institute, Roorkee. The benefits of research should be made available to all concerned including cultivators. (*Para 5.11*)
- XVI (i) In recruitment to the post of operators preference should be given to agriculturally trained persons. (*Para 5.13*)
- (ii) The staff engaged on tube-wells should be given orientation course of training in agricultural practices so that they may be better equipped to devote their spare time to the needs of irrigated agriculture. [*Para 5.13*]
- XVII. Strains of crops suited to local soil conditions and to the quality of water should be developed and popularised by the Agriculture Department in co-operation with the Irrigation Department. [*Para 6.3 (a)*]
- XVIII. In the context of shortage of manure and high cost of fertilizers, concessional water rates may be offered to cultivators for growing green manure crops. (*Para 6.5*)
- XIX. (i) Demonstration farms should be organised in areas having a group of ten or more tube-wells. (*Para 6.6*)
- (ii) Suitable crop pattern should be evolved for areas served by tube-wells and demonstrations with regard to better methods of husbandry, including proper and economic utilisation of tube-well flow should be organised. (*Para 6.6*)



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APPENDICES

- I. Observations of the Team on the Working of State Tubewells on the basis of the data for three years only, i.e., 1955-56, 1956-57 and 1957-58. (1.9 and 5.6)
- II. Statement showing performance of Tubewell groups in Uttar Pradesh. (2.4 and 5.1)
- III. Financial Forecast in respect of Tubewell Projects sanctioned or under sanction in Uttar Pradesh (From beginning to-date) in chronological order. (3.1 and 3.5)
- IV. Statement showing energy charges. (3.9)
- V. Statement showing Tubewells reconstructed by Government. (4.12)
- VI. Project for the construction of 1,500 State Tubewells in Uttar Pradesh proposed in the Second Five Year Plan. Abstract of cost for a Bore-hole Strainer well 12.5 to 20.00 H.P. and 350 ft. depth. (4.14 and 4.20)
- VII. Project for the construction of 1,500 State Tubewells in Uttar Pradesh proposed in the Second Five Year Plan. Abstract of cost of a Bore-hole Slotted well. (4.14)
- VIII. Delay in commission of Tubewells — April, 1959. (4.19)
- IX. The United Provinces Tubewells Act, 1936. (4.26)
- X. Graphs showing Performance and Rainfall Study of Tubewells in Western, Central and Eastern Regions. (5.7)
- XI. Rules for the distribution of the Water from State Tubewells by means of *Osrabandis*. (5.9)
- XII. Terms of Reference.
- XIII. Summary Record of the Proceedings of the Meeting of the Minor Irrigation Team held on the 19th February, 1960 in Room No. II, Udyog Bhavan, New Delhi to discuss tubewell running in U.P.
- XIV. Summary Record of the Proceedings of the Meeting of the Minor Irrigation Team with the Representatives of the Government of Uttar Pradesh held on Sunday the 27th March, 1960 at New Delhi.



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APPENDIX—I

Observations of the Team on the working of State Tubewells on the basis of the data for three years i.e. 1955-56, 1956-57 and 1957-58.

Two views have been expressed in the manner in which productivity tests of tubewells should be assessed. According to one view the working of tubewells in the last 3 to 5 years should be examined. The other view is that the aggregate working results for the 10 years leaving 3 years for the development period should be seen. This is necessary because Uttar Pradesh, as a whole, has rainfall features, which get accentuated in a particular set of years. The latter further argue that the first three years period being developmental in nature should be excluded in computing results. The Team, on the other hand, has suggested that it is possible, to reduce this period considerably by adequate pre-planning.

In exhibiting net results on tubewells it seems necessary to present both the pictures. The former will indicate the present trend of returns on investment made so far, while the latter shows the returns on investment on a long view of it.

The latter picture is the basis of the main report. The results of the examinations of the former are, however, summarised below :—

- (i) Area irrigated per tubewell on 3 years average aggregates to 264 acres against the average C.C.A. of 850 acres. While some tubewells irrigated as much as 700 acres each, others did only a few acres. That brought down the average area irrigated per tubewell.
- (ii) Running hours for the tubewells for the State as a whole averaged only 1892 hours per tubewell per year. Even though, running hours for Daha Group in Meerut Division in 1957-58 averaged to 5749 hours per tubewell, there were many wells in the State, which did not run to an average of $\frac{1}{2}$ hour per day per well. About 125 tubewells in the State were such as had not run even for 100 hours per year on three years average.
- (iii) Taking all the tubewells in the State as a whole, the average assessment per tubewell comes to Rs. 2850/- on a 3 years average. This means a net loss of about Rs. 3,150/- per tubewell based on the fixed over-head charges of Rs. 6,000/- per well apart from the operating cost on account of electricity actually consumed in running the tubewell.

- (iv) While assessment per well for tubewells in Daha group in Meerut is as high as Rs. 7,221/- (in fact one tubewell No. 23 in Bellari Group in Moradabad had attained the figure of 11,080 in 1957-58), there were others in Belan Canal division comprising 167 tubewells, which have an average assessment of Rs. 170/- per well per year. In the case of Pooranpur group in Shahajahanpur division the assessment stood at only Rs. 28/- per tubewell per year.
- (v) The average interest, depreciation and fixed minimum overhead charges remain uniform, regardless of the number of working hours. It will thus be noticed that the cost of running a tubewell per hour is as high as Rs. 12.3 per hour, when it runs for 500 hours a year. It drops down to Rs. 1.69 per hour, when the running hours are 4,000 hours a year and to only Rs. 1.38 per hour when the running period is 5,000 hours.
- (vi) The main solution of the problem, therefore, lies in increasing the number of working hours of the tubewells. Conditions for this should be created in the directions explained in Chapter IV & V of the Report.
- (vii) If the loss is worked out on the basis explained above, the extent of loss is estimated to be Rs. 1.67 *crores* in 1955-56 (4,341 tubewells), 2.19 *crores* in 1956-57 (5,020 tubewells) and 2.14 *crores* in 1957-58 (5,679 tubewells).
- (viii) Besides, the rates for bulk supply of electricity specially applicable to the tubewells are charged by the Electricity Department on a special tariff. This may contain an element of concealed subsidy.

APPENDIX—II

Statement showing performance of Tubewell Groups in Uttar Pradesh

Sl. No.	Name of Groups	Total No. of Tube Wells in operation on 31-3-59	Tube Wells which came into operation after 31-3-56	No. of Tube Wells on which average is worked out	Average area per Well	Average Hours per Well	Average assessment per Well.	Groups
1	2	3	4	5	6	7	8	9

T. W. Circle Meerut

T. W. Division Muzaffarnagar.

1	Dehradun . . .	1	1	..	..	..	..	F1
2	Nakur . . .	47	6	41	342	1,976	3,839	D2
3	North Loi . . .	63	2	61	630	4,354	7,028	A1
4	South Loi . . .	37	2	35	720	5,204	7,542	A2
5	Roorkee . . .	46	4	42	295	1,855	2,937	D3
6	Saharanpur . . .	15	9	6	361	1,839	2,780	D1
7	Deoband . . .	35	11	24	294	2,860	5,892	C1
8	Sardhana* . . .	2	1	1	269	2,780	3,638	
9	Kakra . . .	31	2	29	573	4,047	7,008	A3
10	Kairana . . .	27	9	18	559	3,572	6,211	B1
11	Muzaffarnagar . . .	21	15	6	358	2,272	4,671	C2
12	Jansath . . .	21	7	14	84	3,078	5,795	B2
13	C.P. . . .	7	4	3	463	2,401	5,176	
14	Meerut * . . .	3	..	3	475	3,111	6,726	
	Total of Division	356	73	283	501	3,336	5,036	

T. W. Division Aligarh.

15	Iglas . . .	25	3	22	287	2,172	3,712	C33
16	Sikandrarao . . .	14	14	..	..	..	..	F16
17	Mathura . . .	1	1	..	..	..	..	F17
18	Hathras . . .	37	1	36	525	2,726	3,492	C34
19	Shikarpur* . . .	48	2	46	371	3,186	4,463	
20	Narora . . .	2	..	2	289	2,229	4,066	C15
21	Khurja* . . .	4	3	1	368	2,933	5,015	

* See reference at the end of the Appendix II (Page 58).

APPENDIX—II (contd.)

I	2	3	4	5	6	7	8	9
<i>Tubewell Circle Meerut</i>								
22	West khair .	32	5	27	313	2,439	3,700	C30
23	Dibai . .	33	..	33	419	3,700	5,058	B16
24	Marhara . .	18	..	18	409	2,992	4,442	C28
25	Aligarh . .	66	4	62	374	2,819	4,569	C32
26	Kasganj* . .	28	5	23	326	2,552	3,508	
27	Atrauli . .	134	3	131	434	3,490	4,703	B17
28	East Khair . .	49	..	49	340	2,065	3,575	C31
	Total of Division	491	41	450	393	2,963	4,211	
<i>T. W. Division Bulandshahar</i>								
29	Shikarpur . .	74	4	70	471	4,090	4,925	A8
30	Jhangirabad . .	93	9	84	399	3,434	4,345	B11
31	Khurja . .	14	1	13	262	2,570	3,260	C29
32	Dadri . .	2	2	..	..	..	..	F2
33	Sikandrabad . .	13	4	9	511	4,140	5,630	
34	Kot . .	19	19	..	..	..	..	F3
35	Baniharpur . .	28	28	..	..	..	..	F4
36	Chachura . .	7	7	..	..	..	..	F5
37	Kithor . .	12	..	12	404	3,693	5,222	B9
38	Kutchesar . .	100	6	94	439	3,871	4,784	B10
39	Bulandshahar . .	1	1	..	..	..	..	F6
40	South Bhatipura*	3	1	2	375	4,577	6,030	
41	Upera . .	31	1	30	427	3,851	5,231	B8
42	Hapur . .	115	7	108	427	3,705	4,926	B7
	Total of Division .	512	90	422	427	3,740	4,777	
<i>Tubewell Division Mainpuri</i>								
43	Mainpuri . .	19	10	9	366	2,673	4,763	C24
44	Bhogaon . .	7	4	3	378	2,792	4,909	C23
45	Shikohabad . .	20	11	9	458	3,379	5,661	B19
46	Karhal . .	24	..	24	332	2,787	4,437	C25
47	Jasrana . .	34	2	32	239	2,753	1,842	C27
48	Etah . .	31	8	23	288	1,935	3,726	D10
49	Kasganj . .	9	4	5	475	3,157	6,207	B18
50	Kaimganj . .	23	2	21	262	2,270	4,683	C19
51	Chibramau . .	20	5	15	279	2,170	5,064	C21
52	Kannauj . .	24	6	18	101	1,756	3,151	D13
53	Farrukhabad . .	89	3	86	277	2,090	4,359	C20
54	Bah . .	48	46	2	140	2,046	4,402	C26
55	Agra . .	1	..	1	76	4,212	6,934	A9
56	Aliganj . .	62	..	62	219	1,416	2,725	D9
57	Bithur . .	4	..	4	344	2,695	4,385	C22
	Total of Division	415	101	314	273	2,155	3,818	

*See reference at the end of the appendix II (Page 58)

1	2	3	4	5	6	7	8	9
<i>T. W. Division Meerut</i>								
58	Lohara . . .	52	21	31	518	4,872	7,320	A5
59	South Bhatipura	45	1	44	376	3,456	4,952	B6
60	North Bhatipura	60	6	54	436	3,752	6,205	B5
61	Ghaziabad . .	25	1	24	569	4,576	7,371	A6
62	Daha . . .	40	2	38	679	5,412	8,423	A4
63	Loni . . .	10	5	5	340	1,953	4,124	D5
64	Sardhana . . .	30	5	25	451	3,950	6,008	B3
65	Meerut . . .	43	13	30	412	3,491	6,207	B4
	Total of Division	305	54	251	482	4,121	6,907	
	Total of T.W.							
	Circle	2,079	359	1,720				
	Meerut (excluding Mainpuri Div.)							
Tube Well Circle Moradabad								
<i>T. W. Division Badaun</i>								
66	Budaun . . .	119	7	114	298	2,877	3,489	C17
67	Data Ganj . .	12	12	..	..	..	..	F14
68	Jalalabad . .	17	17	..	..	..	..	F18
69	Sahaswan . .	105	12	93	322	2,300	3,253	C16
70	Bisauli . . .	122	4	118	306	2,633	3,630	C14
71	Aonla . . .	85	19	66	228	1,937	2,543	D8
72	Kakrala . . .	43	8	35	259	2,234	2,584	C18
73	Islamnagar .	66	..	66	312	2,603	3,497	C13
	Total of Division	569	79	490	294	2,499	3,287	
<i>Rampur Canal Division</i>								
74	Shahabad	39	9	30	386	3,015	4,648	B15
75	Bajar Patli . .	15	2	13	228	1,471	1,890	D7
76	Panwaria . . .	3	..	3	171	2,173	2,575	C9
	Total of Division .	57	11	46	327	2,524	3,737	
<i>T. W. Division Shahjhanpur</i>								
77	Shahjhanpur .	1	1	..	..	..	..	F15
78	Pawanyan East .	24	6	18	116	7,43	1,270	E4
79	Pawanyan West .	49	12	37	266	1,897	3,790	D11
80	Mohamadi East	87	8	79	132	898	1,562	E5
81	Mohamadi West	71	2	69	241	1,708	3,136	D12
82	Hardoi . . .	3	3	..	..	..	..	F20
83	Sahabad . . .	11	11	..	..	..	..	F19
84	Bilgram . . .	18	18	..	..	..	..	F21
85	Sitapur . . .	8	5	3	178	995	2,299	E6
86	Misrikh . . .	52	5	47	201	1,423	2,280	D14
87	Biswan . . .	2	2	..	..	..	..	F28

APPENDIX—II (contd.)

1	2	3	4	5	6	7	8	9
88	Lucknow . .	16	..	16	265	1,725	3,688	D15
89	Pilibhit . .	2	2	..	..	..	..	F11
90	Pooranpur . .	8	8	..	..	..	..	F13
	Total of Division .	352	83	269	198	1,374	2,587	
<i>T. W. Division (N) Bijnor</i>								
91	Nehatur . .	69	6	63	354	2,465	3,557	C4
92	Bijnor . .	71	21	50	278	2,308	3,456	C3
93	Chandpur . .	55	6	49	295	2,595	3,734	C6
94	Dhampur . .	68	7	61	350	2,378	3,638	C5
95	Bijnor Canal . .	14	..	14	346	1,985	3,600	D4
96	Amroha . .	109	19	90	311	2,877	4,051	C7
	Total of Division .	386	59	327	320	2,107	3,718	
<i>T. W. Division (S) Moradabad</i>								
97	Bilari . .	32	1	31	361	3,212	4,184	B13
98	Gangan . .	30	1	29	422	3,244	4,158	B14
99	Sirsi . .	114	6	108	382	3,444	6,226	B12
100	Bahjoi . .	66	2	64	338	2,943	4,027	C12
101	Sambhal . .	81	3	78	269	2,811	3,606	C10
102	Chandausi . .	72	2	70	285	2,740	3,732	C11
103	Sarkara . .	1	..	1	258	2,421	2,373	C8
104	Hasanpur . .	76	..	76	171	1,917	2,541	D6
105	Thakurdwara . .	8	8	..	..	..	..	F7
	Total of Division	480	23	457	307	2,873	4,220	
	Total of Circle .	1,844	255	1,589				
Irrigation Works Circle Faizabad								
<i>T.W. Division Faizabad</i>								
106	Faizabad . .	28	1	27	267	1,496	2,878	D18
107	Bikapur . .	154	..	154	216	1,445	2,382	D20
108	Akabarpur . .	58	58	..	..	..	..	F42
109	Ramsanehi Ghat	19	19	..	..	..	..	F33
110	Nawab Ganj . .	2	2	..	..	..	..	F32
111	Sultanpur . .	21	4	17	292	1,871	2,359	D22
112	Kadipur . .	37	29	8	213	1,624	2,646	D23
113	Musafirkhana . .	16	16	..	..	..	..	F16
	Total of Division	335	129	206	229	1,494	2,455	
<i>T.W. Division Azamgarh</i>								
114	Lal Ganj . .	10	4	6	162	1,618	1,800	D35
115	Phool Pur . .	24	17	7	291	1,516	2,183	D31
116	Sagri . .	46	17	29	248	1,327	2,028	D30
117	Azamgarh . .	15	4	11	245	1,686	2,202	D32
118	Ghosi . .	37	6	31	434	1,503	1,961	D34
119	Mohamdbad . .	50	20	30	248	1,819	2,294	D33
	Total of Division	182	68	114	296	1,566	2,094	

1	2	3	4	5	6	7	8	9
<i>T. W. Division Gonda</i>								
120	Kaisar Ganj .	20	20	..	..	..	..	F31
121	Nanpara .	32	32	..	..	..	..	F29
122	Baharaich .	58	58	..	..	..	..	F30
123	Tarabganj .	23	23	..	..	..	..	F35
124	Balrampur .	2	2	..	..	..	..	F36
125	Utrauli .	23	23	..	..	..	..	F37
126	Gonda .	62	32	30	235	1,227	2,420	D16
	Total of Division	220	190	30	..	1,227	2,420	
	Total of Circle .	737	387	350				

Irrigation Works Circle, Gorakhpur

T.W. Division Gorakhpur

127	Gorakhpur .	65	24	41	214	1,896	2,689	D26
128	Sardar Nagar .	28	6	22	234	1,814	3,432	D28
129	Bansgaon .	75	75	..	..	..	..	F44
130	Pharenda .	9	7	2	249	1,682	2,973	D25
131	Maharajganj .	3	..	3	273	2,256	4,320	C35
	Total of Division	180	112	68	224	1,879	3,010	

T.W. Division Basti

132	Basti .	101	31	70	238	1,521	2,541	D21
133	Bansi .	17	17	..	..	..	..	F38
134	Bhadurpur .	12	12	..	..	..	..	F41
135	Harriya .	32	7	25	144	1,011	1,710	D19
136	Domoriya Ganj .	28	16	12	219	1,607	2,519	D17
137	Khalilabad .	76	34	42	212	1,381	2,326	D24
	Total of Division	266	117	149	213	1,403	2,339	

Naraini Canal Division Gorakhpur

138	Nichlaul .	9	9	..	..	..	..	F39
	Total of Division	9	9	..	..	..	..

Irrigation Division Deoria

139	Doeria .	72	26	46	278	2,240	3,415	C37
140	Padrauna .	39	21	18	7	2,589	3,544	C36
141	Hata .	15	15	..	..	..	..	F40
142	Salempur .	72	38	34	193	1,383	2,443	D29
143	Gauri Bazar .	28	..	28	221	1,503	2,987	D27
	Total of Divisions	226	100	126	242	1,896	3,076	
	Total of Circle .	681	338	343				

APPENDIX—II (contd.)

1	2	3	4	5	6	7	8	9
Irrigation Works Circle, Bareilly								
<i>Irrigation Division Kheri</i>								
144	Beganj . . .	17	17	..	..	..	..	F26
145	Aliganj . . .	10	10	..	..	..	..	F23
146	Isanagar . . .	1	1	..	..	..	..	F27
147	Phul Behar . .	1	1	..	..	..	..	F25
148	Nighasan . . .	3	3	..	..	..	..	F24
149	Singhai . . .	7	7	..	..	..	..	F22
150	Pilibhit* . . .	1	1	..	..	..	..
	Total of Division	40	40					
<i>Tarai Division Bareilly</i>								
151	Bareilly . . .	31	31	..	..	..	..	F41
152	Baheri . . .	10	10	..	..	..	..	F10
153	Bilaspur . . . (Energized wells)	4	4	..	..	..	..	F9
154	Bilaspur* . . . (Artesian wells)	6	6	..	..	..	..
155	Baz Pur . . . (Artesian wells)	6	6	..	..	..	..	F8
156	Kichha . . . (Artesian wells)	7	7	..	..	..	..	E3
157	Kichha* . . . (Energized wells)	11	4	7	45	832	619	
158	State Farm . .	12	12	..	..	..	..	E2
159	State Farm* . . (Energized wells)	7	..	7	70	831	616	
	Total of Division	94	80	14	58	832	618	
<i>Afzalgarh Irrigation Division Moradabad</i>								
160	Kashi Pur . . . (Artesian wells)	5	5	..	..	..	..	E 1
161	Kashi Pur* . . . (Energized wells)	8	1	7	63	712	612	
	Total of Division	13	6	7	63	712	612	
	Total of Circle	147	126	21				
Bundelkhand Development Circle, Allahabad								
<i>Belan Canal Construction Division</i>								
162	Kara . . .	6	6	..	..	..	..	F 45
163	Phul Pur . . .	34	34	..	..	..	..	F 47
164	Handia . . .	76	76	..	..	..	..	F 48
165	Chail . . .	5	5	..	..	..	..	F 46
	Total of Division	121	121					
	Total of Circle	121	121					

*See reference at the end of Appendix II (Page 58).

1	2	3	4	5	6	7	8	9
Irrigation Works Circle, Varanasi								
<i>Irrigation Division Varanasi</i>								
166	North Varanasi .	76	45	31	206	2,275	3,151	C 42
167	South Varanasi	75	28	47	247	2,403	3,242	C 43
168	Bhadohi .	100	73	27	252	2,472	4,480	C 44
169	Mughalsarai .	11	11	..	..	..	..	F 50
170	Mirzapur .	46	46	..	..	..	..	F 49
171	Jaunpur .	40	29	11	195	2,339	2,594	C 45
172	Marihaun .	47	42	5	166	1,698	2,785	D 37
173	Shahganj .	22	22	..	..	..	..	F 43
174	Kerakat .	31	27	4	223	2,388	2,941	C 41
175	Machhlishahar .	13	11	2	228	1,534	2,804	D 36
		461	334	127	229	2,339	3,393	

Irrigation Division Ghazipur

176	Bansdih .	13	9	4	341	2,231	3,611	C 39
177	Ballia .	50	38	12	195	1,318	2,171	D 40
178	Rasra .	67	26	41	292	2,637	2,613	C 38
179	Mohamdabad (Yusufpur) .	48	29	19	248	1,761	2,677	D 39
180	Saidpur .	53	41	12	268	2,116	2,701	C 40
181	Ghazipur .	46	16	30	200	1,778	2,309	D 38
	Total of Division	277	159	118	251	2,077	2,544	
	Total of Circle .	738	493	245				
	Total for U.P. .	6,347	2,079	4,268				

Category

		No. of Groups	Total No. of T.Ws.
Category	A Over 4000 Hours	10	300
Category	B Between 3,000 to 4,000 Hrs.	21	938
Category	C between 2,000 to 3,000 Hrs.	49	1,680
Category	D between 1,000 to 2,000 Hrs.	40	1,229
Category	E between 500 to 1,000 Hrs.	6	121
	No. of T.Ws. in the above groups (126 groups) which came into operation after 31-3-56.		1,222
Category	F Tubewells group which came into operation after 31-3-59	55	857
	TOTAL .	181	6,347

APPENDIX—II (concl'd.)

Reference

In Appendix II and annexure to Figure 2·1 some groups appear under different Divisions and Circles and belong to separate categories, and for convenience these have been grouped in Map (Figure 2·1) as shown below.

Group	Serial No.	Category	No. of T.W.	Final Category
Meerut	14	B	3	B ₄
	65	B	43	
Shikarpur	19	B	48	A ₄
	29	A	74	
Kasganj	26	C	28	B ₁₈
	49	B	9	
South Bhatipura	40	A	3	B ₈
	59	B	45	
Bilaspur	153	F	4	F ₀
	154	F	6	
Kichha	156	F	7	E ₇
	157	E	11	
State farm	158	F	12	E ₈
	159	E	7	
Kashipur	160	F	5	E ₁
	161	B	8	
Sardhana	8	C	2	B ₀
	64	B	30	
Khurja	21	C	4	C ₁₀
	31	C	14	
Pilibhit	89	F	2	F ₁₁
	150	F	1	

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APPENDIX—III

Financial forecast in respect of Tube Well Projects sanctioned or under sanction in Uttar Pradesh:
(From beginning to-date in chronological order)

SL. No.	Name of the Project	Year of sanction	Total Capital cost per tubewell in lakhs of Rs.	Total Gross Revenue and expenses per tubewell in lakhs of Rs.	Total Working Expenses per tubewell in lakhs of Rs.	Net gain (+) or loss (—) in lakhs of Rs.	Net return excluding interest charges (%)	Name of Districts
1	2	3	4	5	6	7	8	9
1	1,656 State Tubewells project (Old)	1936	187.59 0.113	50.60 0.0306	39.25 0.0237	+11.35 +0.0069	6.05	Saharanpur (10), Muzaffarnagar (94), Meerut (274), Bulandshahar (198), Aligarh (40), Etah (16), Bareilly (63), Bijpur (148), Budaun (336), Moradabad (477).
2	600 State Project Tubewells	1946	161.75 0.2696	22.98 0.0383	22.15 0.037	+0.83 +0.0014	0.51	Saharanpur (3), Muzaffarnagar (41), Meerut (82), Bulandshahar (128), Aligarh (169), Etah (20), Bijpur (29), Budaun (55), Moradabad (73).
3	51 Addl. State Tube Wells Project	1949	17.45 0.342	1.75 0.0348	1.45 0.0290	+0.30 +0.0058	1.72	Bareilly (1), Bijpur (15), Budaun (21), Moradabad (14).

1	2	3	4	5	6	7	8	9
4	200 Tube Wells projects in Western Districts	1950	71.25 0.3562	10.16 0.0508	7.16 0.0358	+3.00 0.0150	4.21	Saharanpur (4), Muzaffarnagar (11), Meerut (38), Bulandshahar (18), Aligarh (122), Bareilly (7), Faizabad (60).
5	60 State Tubewells Project in Faizabad	1952	22.00 0.366	2.82 0.047	3.39 0.056	—0.57 0.009	—3.0	
6	14 State Tubewells Project in Bijnor	1952	4.69 0.3347	0.729 0.052	0.6682 0.0477	+0.06 (+)0.0044	1.3	Bijnor (14).
7	995 State Tubewells Project (Revised)	1953						
(a)	295 Tubewells in Gorakhpur	"	148.30 0.50	17.69 0.059	21.30 0.072	—3.60 0.012	—2.40	Gorakhpur (65), Deoria (110), Basti (130), Mainpuri (95), Farrukhabad (151), Etah (95), Agra (11), Mathura (1), Faizabad (121), Sultanpur (74), Barabanki (18), Azamgarh (41), Jaunpur (19), Varanasi (25), Allahabad (44).
(b)	340 Tubewells in Mainpuri	"	206.33 0.606	24.99 0.073	38.00 0.111	—13.10 0.038	—6.30	
(c)	360 Tubewells in Faizabad	"	212.52 0.59	21.60 0.0600	23.02 0.0639	—1.42 0.0039	—0.67	
8	80 State Tubewells in Varanasi and Jaunpur (Capital cost is including electrification)	1954	48.06 0.600	6.30 0.079	8.20 0.10	—1.900 0.021	—6.40	Varanasi (50), Jaunpur (30).
9	440 State Tubewells project	1955	205.01 0.465	28.43 0.065	23.13 0.053	+5.30 +0.012	+2.60	Saharanpur (99), Muzaffarnagar (1), Shahjahanpur (55), Sitapur (47), Kheri (148), Faizabad (56), Gonda (30), Azamgarh (2), Ghazipur (1), Ballia (1).

10	100 State Tubewells project in Gorakhpur	1955	37.69	5.417	6.49	-1.07	-2.90	Gorakhpur (22), Deoria (28), Basti (50).
11	75 Tubewells Project in West	1956	29.02	5.16	3.79	+1.37	+4.46	Muzaffarnagar (15), Meerut (30), Bulandshahar (20), Bareilly (10).
12	200 State Tubewells Project in Eastern Districts	1956	82.47	12.00	12.80	-0.08	-0.97	Ghaziपुर (40), Ballia (40) Azamgarh (70), Gorakhpur (20), Bahraich (30).
13	50 State Tubewells Project in Bahraich	1956	18.96	4.09	4.14	-0.05	-0.28	Bahraich (50).
14	30 State Tubewells Project in Varanasi	1956	11.86	1.80	2.09	-0.28	-2.40	Varanasi (30).
15	90 Feeder Wells in Mat Branch (Revised)	1956	51.32	5.68	4.43	+1.23	+2.40	Bulandshahar (90).
16	85 State Tubewells Project under G.M.F.	1957	29.92	5.54	6.00	-0.46	-1.53	Gorakhpur (25), Deoria (25), Basti (20), Gonda (15).
17	280 State Tubewells T.C.M. Project	1957	122.85	15.09	15.65	-0.56	-0.46	Varanasi (95), Jaunpur (45) Ghazipur (35), Ballia (35), Azamgarh (35), Tarai (35).
18	25 State Tubewells in Kakrala	1956	8.19	0.84	1.119	-0.27	-3.40	Budaun (15), Shahjahanpur (10).
19	420 Tubewells Project	..	167.03	25.20	26.75	-1.55	-0.93	Muzaffarnagar (5), Meerut (8), Bulandshahar (6), Aligarh (10), Agra (40), Etah (2), Bareilly (30).

APPENDIX—IV
Statement showing Energy Charges

Source of Supply	Total No. of wells	Average running hours	Average units consumed per well per hour	Operative energy Charges				Total energy charges in Rupees			
				Fixed charges		Energy charges on the basis of units consumed		Amount in Rupees		Rupees	
				Quantity	Rate	Amount in Rupees	Quantity	Rate	Amount in Rupees	Quantity	Rate
	1	2	3	4	5	6	7	8	9	10	11
Ganga Grid	2,859 (140 B.H.P. motors).	3,000	10	40,026 B.H.P.	Rs. 80/- per B.H.P.	32,02,080	1957-58 (with interim power arrangements) 8,57,70,000 3.5 pies per unit				
Sarda Grid	689 (15 H.P. motors).	2,000	10	10,335 B.H.P.	Rs. 100/- per B.H.P.	10,33,500	1,37,80,000	3.5 pies per unit.	2,75,600	17,15,400	49,17,540
Steam Power Station in Eastern U.P.	1,177	1,700	11	..	..	..	2,19,82,700	2 1/2 as. per unit.	34,65,174	34,65,174	34,65,174
Power Houses run by Diesel.	400	1,500	11	..	..	..	66,00,000	3 as. per unit.	12,37,500	12,37,500	12,37,500
	5,125									1,09,29,314	
Ganga Grid	2,859	3,000	10	40,026 B.H.P.	Rs. 80/- per B.H.P.	32,02,080	1957-58 (If electricity had been supplied to Eastern Districts from Rihand) 8,57,70,000 3.5 pies per unit.				
Sarda Grid	689	2,000	10	10,335 B.H.P.	Rs. 100/- per B.H.P.	10,33,500	1,37,80,000	3.5 pies per unit.	2,75,600	17,15,400	49,17,540
Rihand Power	1,177	1,700	11	..	..	..	2,19,82,700	-1/- per unit.	13,73,919	13,73,919	13,73,919
Rihand Power	400	1,500	11	..	..	..	66,00,000	-1/- per unit.	4,12,500	4,12,500	4,12,500
										80,13,059	
											29,16,255

Difference between cost of electricity
as per interim arrangements and
as stipulated in the Projects

Name of Division	T. Ws. recons- tructed in less than 10 Yrs.		T. Ws. recons- tructed between 10 to 15 Yrs.		T. Ws. recons- tructed between 15 to 17 Yrs.	
	No. of T.Ws.	Average Hrs. per well	No. of T.Ws.	Average Hrs. per well	No. of T.Ws.	Average Hrs. per well
1	2	3	4	5	6	7
<i>Tubewell Circle Meerut</i>						
T. W. Divn. Muzaffarnagar . .	8	23,717	16	52,840	6	81,337
T. W. Divn. Aligarh . .	51	11,225	19	39,052	9	53,840
T. W. Divn. Meerut . .	10	31,274	36	61,879	14	85,410
T. W. Divn. Mainpuri . .	..	..	..	..	..	..
T. W. Divn. Bulandshahar . .	3	15,526	..	..	..	..
Total of Circle . .	72	15,577	71	55,086	29	74,771
<i>Tubewell Circle Moradabad</i>						
T. W. Divn. Budaun . .	22	10,168	32	24,362	10	29,198
Rampur Canal Divn. . .	2	13,280	3	26,769	1	50,992
T. W. Divn. Bijnor . .	21	29,605	19	36,332	10	41,452
T. W. Divn.(s) Moradabad . .	4	22,284	27	28,347	10	46,247
T. W. Divn. Sh <h>jahanpur . .</h>
Total of Circle . .	49	19,614	81	28,349	31	29,481

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APPENDIX—V

Statement showing Tubewells reconstructed by Government

T. Ws. recons- tructed between 17—20 Yrs.		T. Ws. recons- tructed between 20—25 Yrs.		T. Ws. recons- tructed after 25 years		T. Ws. running Beyond 20 yrs. of life at present	T. Ws. running beyond 25 yrs. of life at present	Total No. of Tube- wells recons- tructed	Total No. of Tube- wells in ope- ration on 31-3-1959
No. of T. Ws.	Average Hrs. per well	No. of T. Ws.	Average Hrs. per well	No. of T. Ws.	Average Hrs. per well				
8	9	10	11	12	13	14	15	16	17
25	1,00,224	6	106,747	..	..	42	..	61	356
16	64,205	10	77,919	..	..	41	..	105	491
29	37,679	17	107,796	..	..	52	12	106	305
..	..	..	..	..	..	..	..	..	415
..	..	..	..	..	..	..	..	3	512
70	86,794	33	96,532	..	..	135	12	275	2,079
24	45,793	45	51,404	..	..	238	..	133	569
2	21,040	1	80,548	..	..	18	..	9	57
13	50,073	5	42,629	..	..	176	32	70	386
32	49,844	68	60,056	1	72,948	243	30	142	480
..	..	..	..	..	..	..	..	..	352
71	47,706	119	58,241	1	72,948	675	62	354	1,844

APPENDIX—VI

Project for the construction of 1500 State Tubewells in Uttar Pradesh proposed in the Second Five Year Plan.

Abstract of cost of a Borehole strainer well 12·5 to 20 H.P. and 350 ft. depth.

Sl. No.	Details	Unit	No.	Rate Rs.	Amount Rs.	Total Rs.
1	2	3	4	5	6	7
1.	A. Preliminary . . .	Job	1	100	100	100
2.	B. Land					
	(a) Permanent land . . .	Acre	3·7	250	925	
	(b) Temporary Land & crop compensation. . .	Job.	1	50	50	975
3.	C. Works					
	(a) Pump house excluding delivery tank. . .	No.	1	600	600	
	(b) Lined channel . . .	Mile	15/16	5,880	5,512	
	(c) Syphon					
	(i) Under Kacha Road . . .	No.	3	100	300	
	(ii) Under Metalled Road . . .	No.	1	500	500	
	(iii) Under Service Road . . .	No.	3	100	300	
	(d) Sumps (Head Intermediate and end) . . .	Job	1	900	900	
	(e) Service Road . . .	Mile	1	500	500	
	(f) Unlined Channel . . .	Mile	1	700	700	
	(g) Boundary Stone . . .	No.	L.S.	85	85	
	(h) Pipe Line . . .	Mile	1·8	9,945	1,243	10,820
	(i) W.C. Staff . . .	Month	2	90	180	
4.	Q. Equipment.					
	(a) 16" boring including extraction . . .	Ft.	350	10	3,500	
	(b) Transport of boring equipment . . .	Job	1	300	300	
	(c) 12" Housing Pipe . . .	Ft.	90	28	2,520	
	(d) 6" Blind Pipe . . .	Ft.	160	9	2,080	
	(e) Agri-Strainer . . .	Ft.	100	18	1,800	
	(f) Transport of items (d) to (i) . . .	Job	1	300	300	

APPENDIX—VI—(contd.)

Sl. No.	Details	Unit	No.	Rate Rs.	Amount Rs.	Total Rs.
1	2	3	4	5	6	7
(g)	Borehole pump 12.5 to 20 H.P.	No.	1	5,600	5,600	
(h)	Starter . . .	No.	1	280	280	
(i)	Other accessories and installation . . .	Job	1	600	600	
(j)	Work charged staff .	Month	2	90	180	17,230
(k)	Ammeter . . .	No.	1	70	70	
Total						29,125
Contingencies @3%						874
Grand Total						29,999



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APPENDIX—VII

Project for the construction of 1500 State Tubewells in Uttar Pradesh proposed in the Second Five Year Plan.

Abstract of cost of a Borehole Slotted well.

Sl. No.	Details	Unit	No.	Rate Rs.	Amount Rs.	Total Rs.
1	2	3	4	5	6	7
1.	A. Preliminary . . . Job		1	100	100	100
2.	B. Land					
	(a) Permanent Land . . Acre		3.7	250	925	
	(b) Crop compensation . . Job		1	50	50	975
3.	C. Works Same as in appendix VI					10,820
4.	D. Equipment					
	(a) 27" boring (with Rig) including extraction :					
	(i) 0-300 feet. . . Ft.		300	25	7,500	
	(ii) 300-350 feet. . . Ft.		50	30	1,500	
	(b) Transport of boring equipment . . Job		1	300	300	
	(c) 12" Housing Pipe . . Ft.		90	28	2,520	
	(d) 6" Blind Pipe . . Ft.		160	13	2,080	
	(e) 6" Slotted Pipe . . Ft.		100	16	1,600	
	(f) Transport of item (c) to (e) . . . Job.		1	300	300	
	(g) Development by air compressor . . Hour		100	25	2,500	
	(h) Cost of gravel . . cft.		1,100 cft.	2	2,200	
	(i) Borehole pump 12.5 to 20 HP . . No.		1	5,600	5,600	
	(j) With starter . . No.		1	280	280	
	(k) Ammeter . . No.		1	70	70	
	(l) Other accessories & installation . . Job		1	600	600	
	(m) Work charged staff. . Month		2	90	180	27,230
Total						39,125
Contingencies@3%						1,174
Grand Total						40,299

APPENDIX—VIII

Delay in commission of Tubewells.—April 1959

The wells which were not ready but for which lines and sub-stations had been constructed.

Sl. No.	District	No.	Group-wise Details	
1	Aligarh	4	Iglas Group:—26 Hathras Group:—42 Atrauli Group:—135,136	} 4 numbers
2	Saharanpur	5	Nakur Group:—43,44,45,46 Deoband Group:—31	} 5 "
3	Meerut	3	Ghaziabad Group:—30,31 North Bhatipura Group:—36	} 3 "
4	Bulandshahar	1	Sikandrabad Group No. 17	1 "
5	Budaun	1	Sahaswan Group:—104	1 "
6	Rampur	1	Sahabad:—37	1 "
7	Mainpuri	2	Jasrana:—47 Shikohabad:—29	} 2 "
8	Ghazipur	3	Saidpur Group:—47 Yusufpur Group:—49,51	} 3 "
9	Ballia	6	Rasra Group:—51,12 Bansdih Group:—14,15,16,17	} 6 "
10	Lakhimpur Kheri	10	Aliganj Group:—1,2,3,4,5, 6,7,8,9,10	} 10 "
11	Basti	2	Domariaganj Group:—13 Basti Group:—133	} 2 "
12	Gorakhpur	3	Pharenda :—2,11,13	3 "
13	Azamgarh	1	Mohamdadabad:—Walidpur	1 "
14	Faizabad	1	Akbarpur Group:—73	1 "
15	Shahjahanpur	2	Jalalabad Group:—15,17	2 "
16	Muzaffarnagar	1	South Loi Group:—31	1 "
Total		46		

APPENDIX—IX

THE UNITED PROVINCES STATE TUBEWELLS ACT, 1936

**(Passed by the Legislative Council of the United Provinces of
Agra and Oudh)**

*An Act to provide for the construction, improvement and maintenance of
State tube-well irrigation works*

Preamble

Whereas it is expedient to make provision for the construction, improvement and maintenance by Government of State tube-well irrigation works;

And whereas the previous sanction of the Governor General under sub-section (3) of Section 80-A of the Government of India Act has been obtained to the passing of this Act ;

It is hereby enacted as follows :

Short title, extent and commencement

1. (1) This Act may be called the United Provinces State Tubewells Act, 1936.
- (2) Subject to the provisions of section 3, it extend to the whole of the United Provinces of Agra and Oudh.
- (3) It shall come into force on such date as the Local Government may by notification in the Gazette appoint.

Definitions

2. In this Act, unless there be something repugnant in the subject or context,
 - (1) "tube-well" means any tube-well from which water is lifted by means of a pump operated otherwise than by human or animal power ;

- (2) "State tube-well" means a tube-well constructed, maintained or controlled by the Local Government and includes all mechanical and electrical appliances, tools and structures appertaining to it and necessary for the abstraction of water from it ;
- (3) "Tube-well Officer" means an officer appointed under section 4 to exercise control or jurisdiction over one or more State Tube-wells ;
- "Superintending Engineer" means a Tube-well Officer exercising general control over a circle comprising one or more tubewell divisions ;
- "Divisional Officer" means a Tube-well Officer exercising control over a division comprising one or more tube-well sub-divisions ;
- "Sub-Divisional Officer" means a Tube-well Officer exercising control over a group of State tube-wells situated within an area designated a tube-well sub-division.

3. *Application of the Act*

The Local Government may by notification in the Gazette, declare that any tract of land is a tract to which this Act will apply with effect from a day to be named in the notification, not being earlier than three months from the date thereof.

4. *Appointment of Tube-well officers*

The Local Government may from time to time appoint officers to exercise or perform within such local limits as it may direct all or any of the powers and duties conferred or imposed on Tube-well officers by the Northern India Canal and Drainage Act, 1873, in its application to State tube-wells, as hereinafter provide.

Act VIII of
1873.

5. *United Provinces Act I of 1920 not to apply to State Tube-wells.*

United
Provinces Act
I of 1920.

The provisions of the United Provinces Minor Irrigation Works Act, 1920 shall not apply to State tube-wells.

6. *Application of Act VIII of 1873 to State tube-wells*

In respect of any State tube-well the provisions of the Northern India Canal and Drainage Act, 1873 except the provisions of section 1, clauses (4) and (7) of section 3, section 4, section 5 and Parts VI and VIII of the said Act, shall be deemed to apply in like manner as if such State tube-well were a canal within the meaning of the said Act :

Act VIII of
1873.

Provided that in the application of the said Act every reference therein to a "Canal Officer" (except in section 27 of the said Act), a "Superintending Canal Officer", a "Divisional Canal Officer" or a "Sub-Divisional Canal Officer" shall be deemed to be a reference to a "Tube-well officer", a "Superintending Engineer", a "Divisional Officer" or a "Sub-Divisional Officer" respectively :

Provided further that for the purpose of such application the said Act shall be subject to the modifications indicated in the Schedule.

SCHEDULE

(Referred to in section 6)

Act VIII
of 1873. Modifications in the Northern India Canal and Drainage Act, 1873 (hereinafter called "the said Act").

1. In section 6 of the said Act for the words "so named" the words "named in a notification under section 3 of the United Provinces State Tube-wells Act, 1936" shall be deemed to be substituted, and for the words "such application or use of the said water" the words "the application or use of underground water for the purpose of a State tube-well" shall be deemed to be substituted.

3. In section 27 of the said Act for the words "Canal Officer" the words "Divisional Officer" shall be deemed to be substituted.

4. (1) In sub-clause (i) of clause (a) of section 32 of the said Act the words "and with the previous sanction of the Local Government" shall be deemed to be omitted.

(2) Clause (d) of section 32 of the said Act shall be deemed to be omitted.

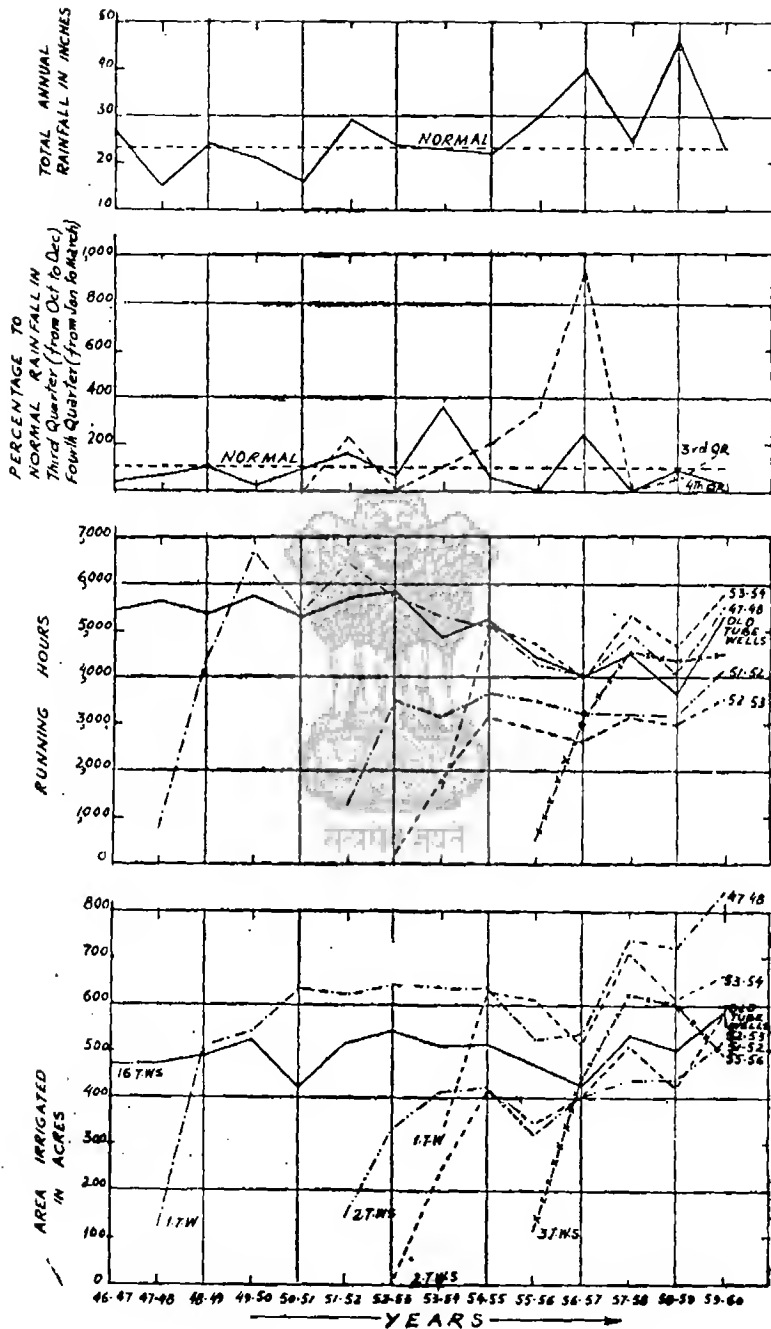
5. In section 68, for the words "Such Officer shall thereupon give notice" the words "on receipt of such application or when in the opinion of the Divisional Officer any such difference is likely to arise he shall give notice" shall be deemed to be substituted.

6. In clause (2) of section 70 the words "except by the construction of a tube-well" shall be deemed to be inserted before the word "interferes" and clauses (6) to (9) of the said section shall be deemed to be omitted.

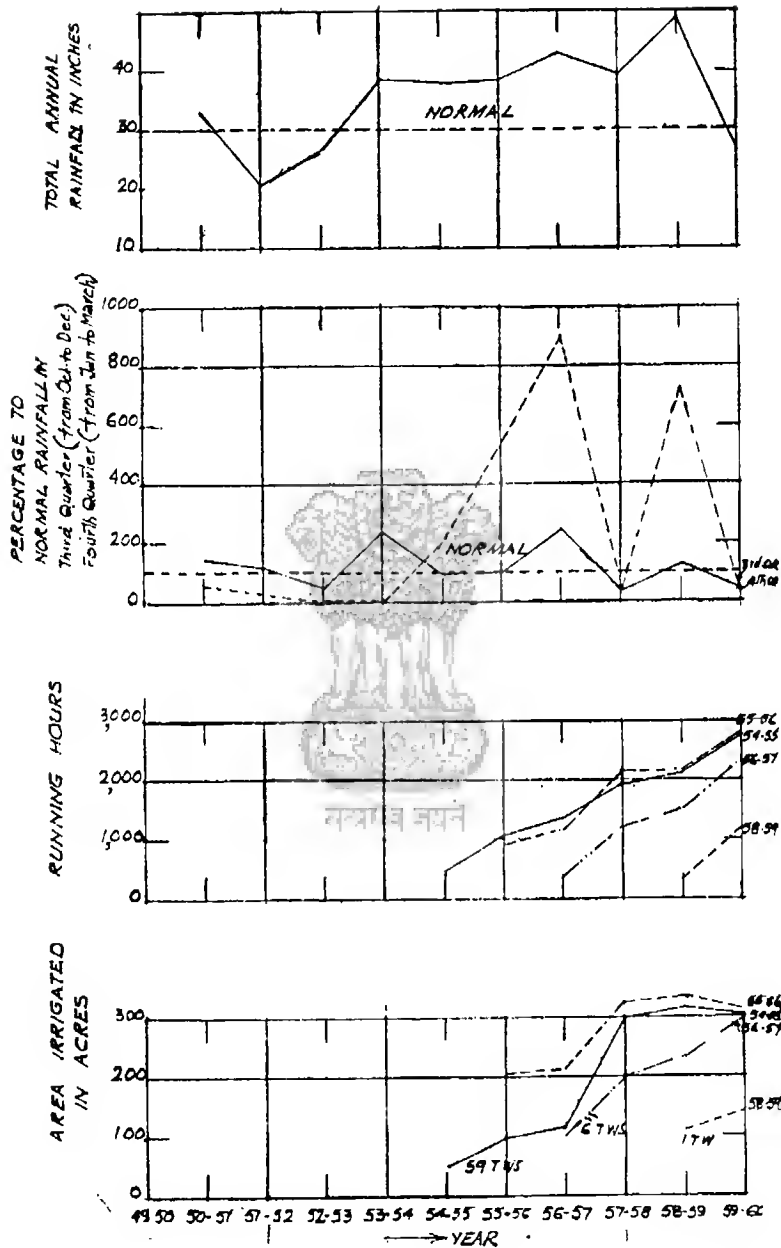
APPENDIX—X

Representative Groups of Tubewells whose performance and rainfall at Tehsil Headquarters have been plotted. (Graphs 1—14).

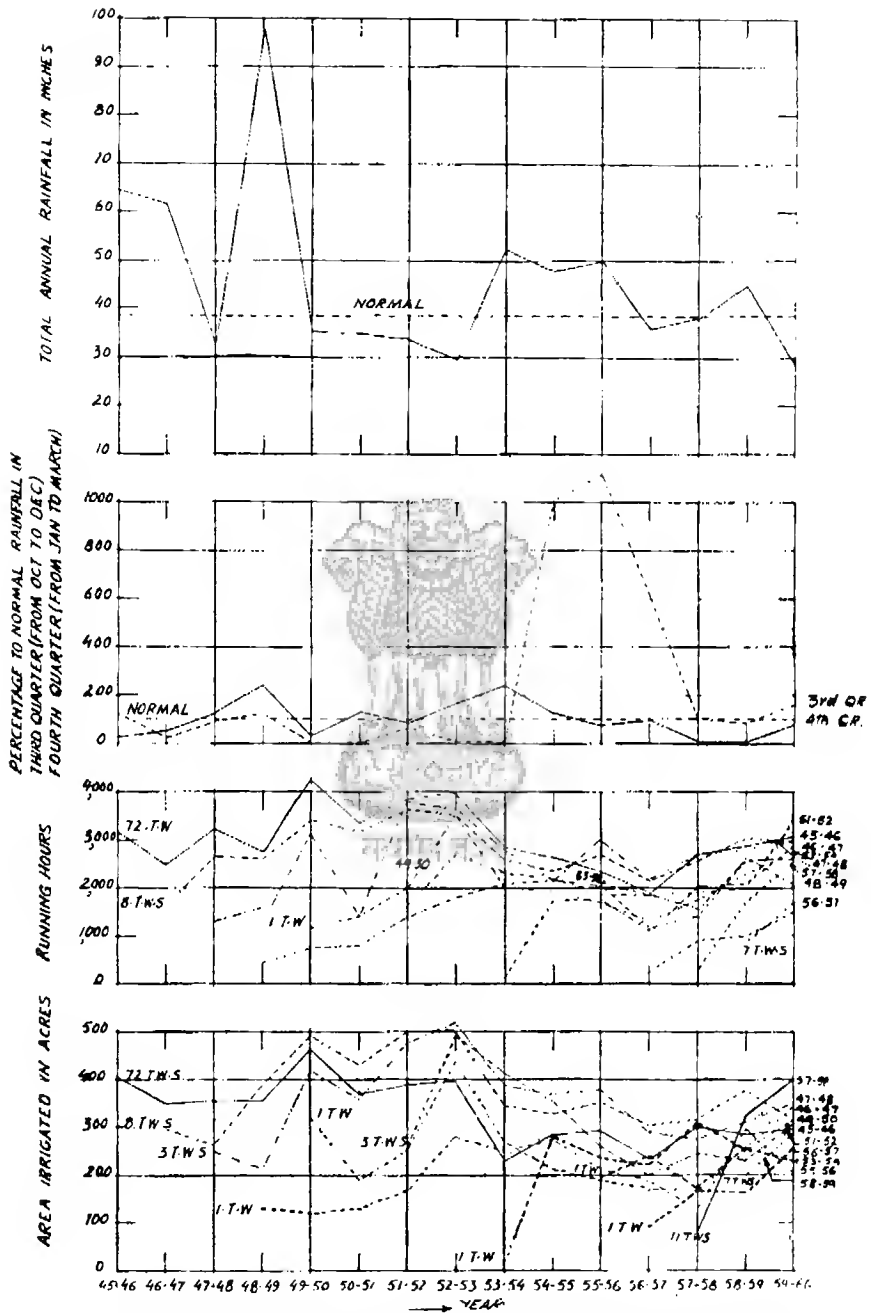
Name of Group	Graphs as plotted	Location of Group
Ghaziabad . . .	1 Western Region	Tubewell division, Meerut, Distt. Meerut.
Farrukhabad . . .	2 Central Region	T. W. Divn. Mainpuri, Distt. Farrukhabad.
Amroha	3 Central Region	T. W. Divn. (North) Bijnor, Distt. Moradabad.
Hapur	4 Western Region	T. W. Divn. Bulandshahar, Distt. Meerut.
Aonla	5 Central Region	T. W. Divn. Budaun, Distt. Bareilly.
Sirsi	6 Central Region	T. W. Divn. (South) Moradabad, Distt. Moradabad.
Roorkee	7 Western Region	T. W. Divn. Muzaffarnagar, Distt. Saharanpur.
West Kha'r	8 Western Region	T. W. Divn. Aligarh, Distt. Aligarh.
Gorakhpur	9 Eastern Region	T. W. Divn. Gorakhpur, Distt. Gorakhpur.
Deoria	10 Eastern Region	Irrig. Divn. Deoria, Distt. Deoria.
South Varanasi	11 Eastern Region	Irrig. Divn. Varanasi, Distt. Varanasi.
Jaunpur	12 Eastern Region	Irrig. Divn. Varanasi, Distt. Jaunpur.
West Mohamadi	13 Central Region	T. W. Divn. Shahjahanpur, Distt. Shahjahanpur.
Rasra	14 Eastern Region	Irrig. Divn. Ghazipur, Distt. Ballia.



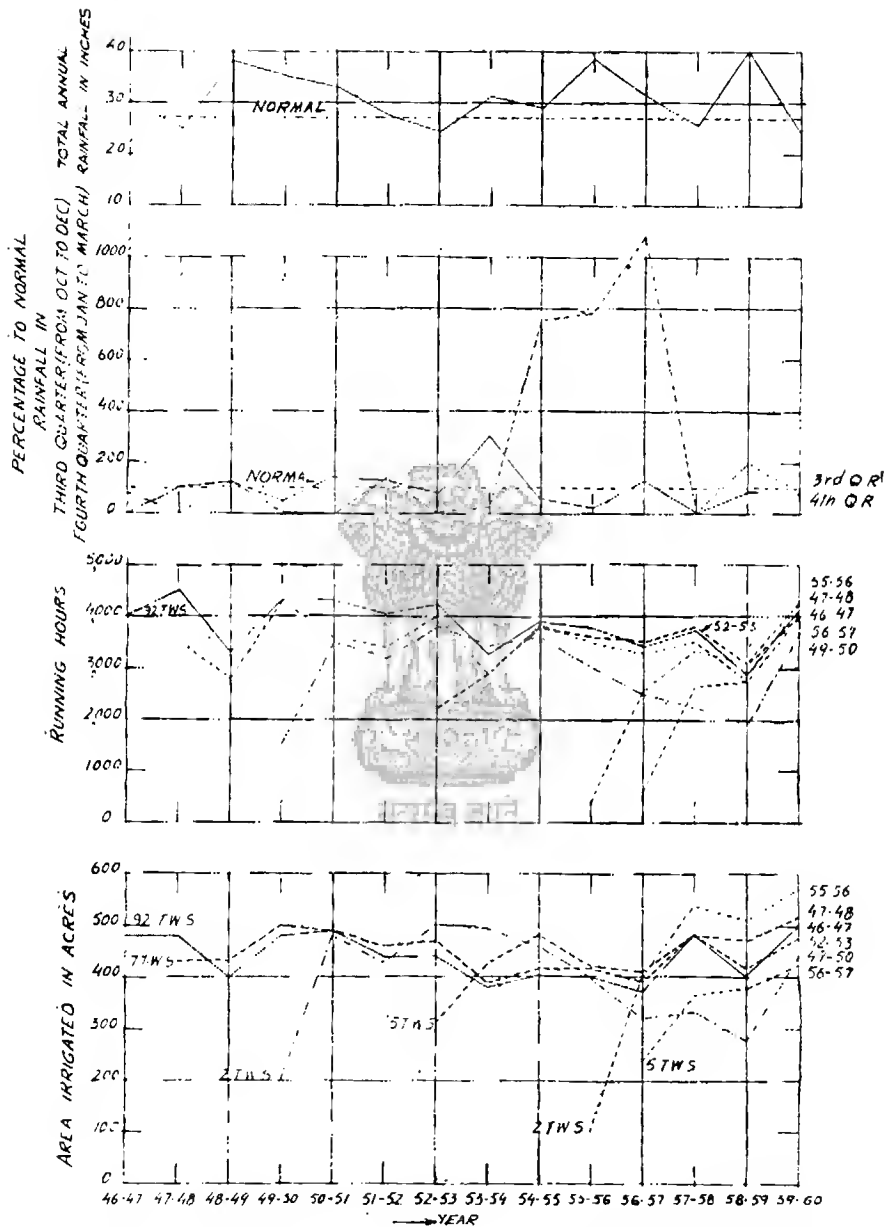
GRAPH I :—Showing plottings of rainfall, total and normal; running hours of Tubewells and area irrigated in acres in Western Region : Ghaziabad Group (Tubewell Division, Meerut).



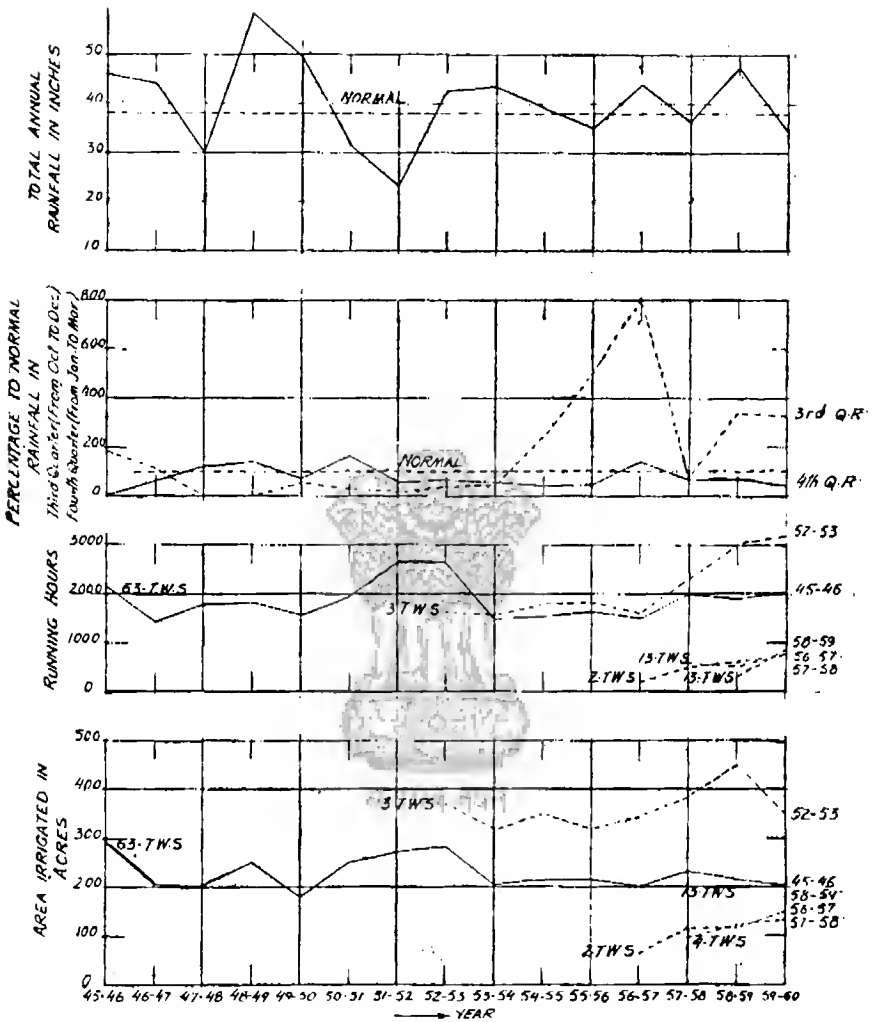
GRAPH 2 :—Showing plottings of rainfall, total and normal; running hours of Tubewells and area irrigated in acres in Central Region, Farrukhabad Group (Tubewell Division, Mainpuri).



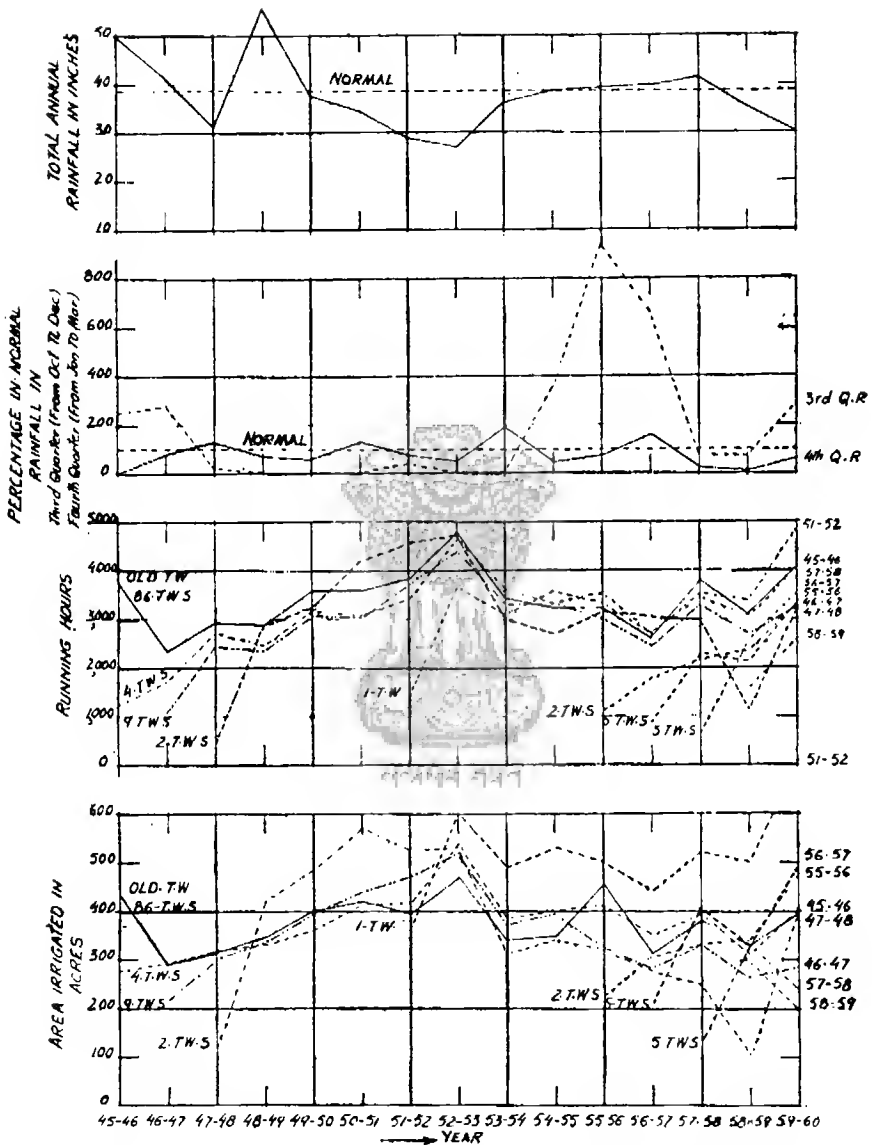
GRAPH 3 1—Showing plottings of rainfall, total and normal; running hours of Tubewells and area irrigated in acres in Central Region : Amroha Group (Tubewell Division, North, Bijnor).



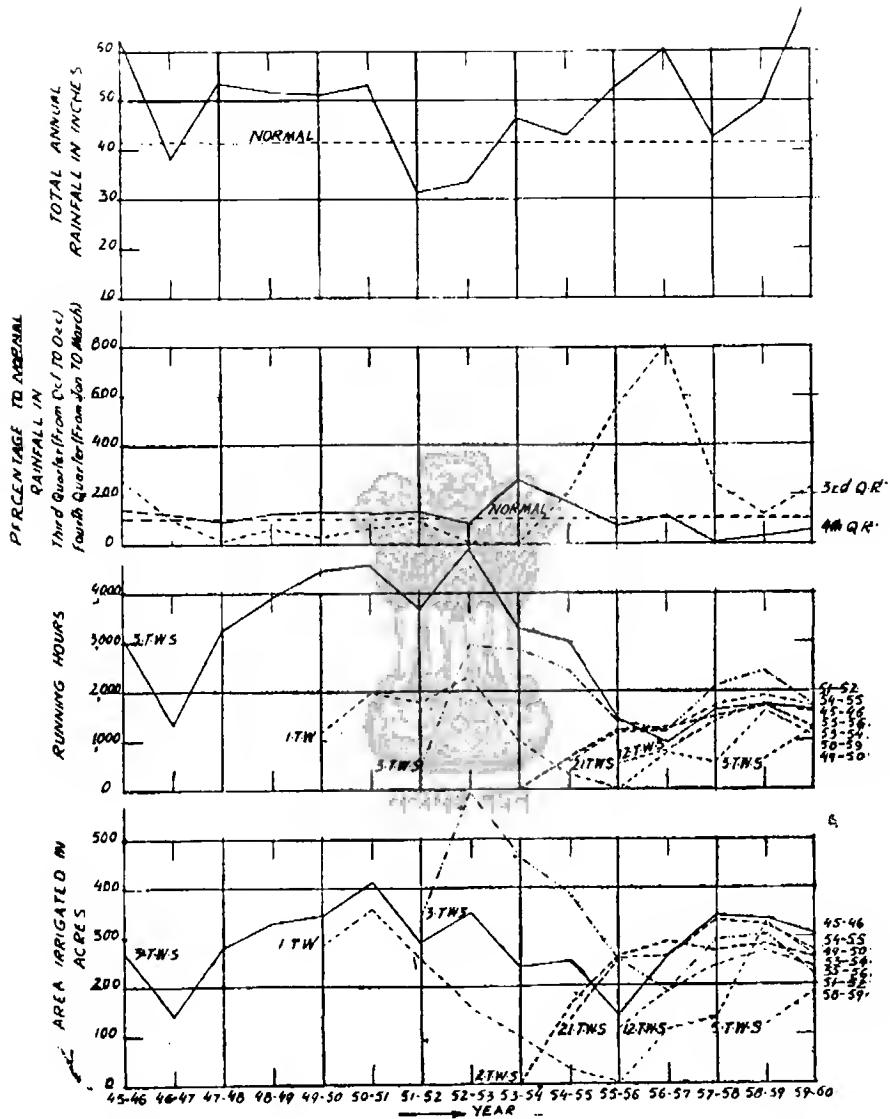
GRAPH 4 :—Showing plottings of rainfall, total and normal ; running hours of Tubewells and area irrigated in acres in Western Region: Hapur Group (Tubewell Division, Bulandshahar).



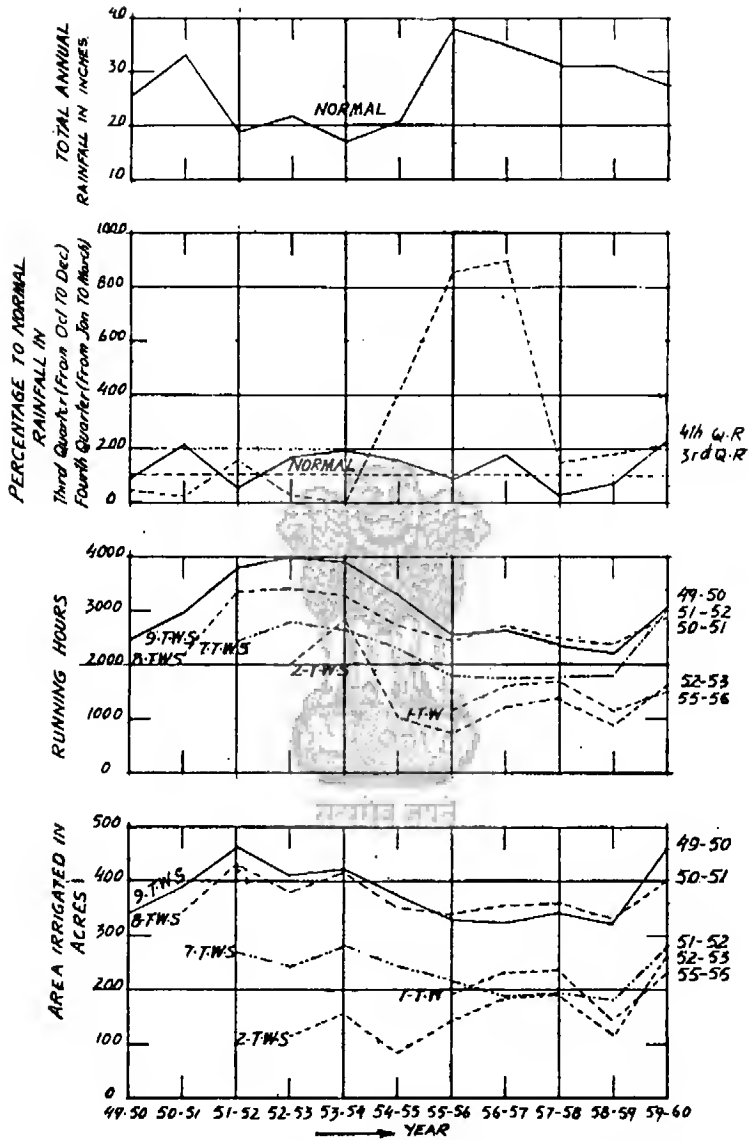
GRAPH 5 :—Showing plottings of rainfall, total and normal; running hours of Tubewells and area irrigated in acres in Central Region : Aonla Group (Tubewell Division, Budaun).



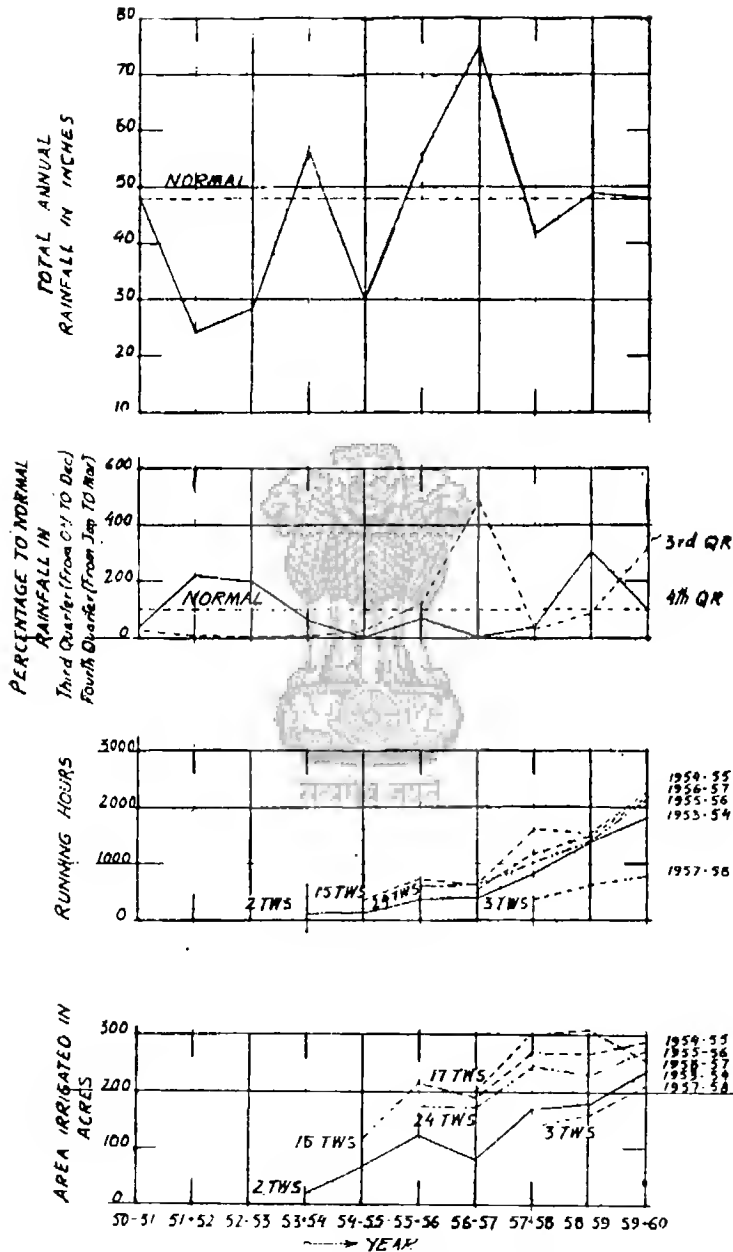
GRAPH 6 :—Showing plottings of rainfall, total and normal ; running hours of Tubewells and area irrigated in acres in Central Region ; Sirsi Group (Tubewell Division, South Moradabad).



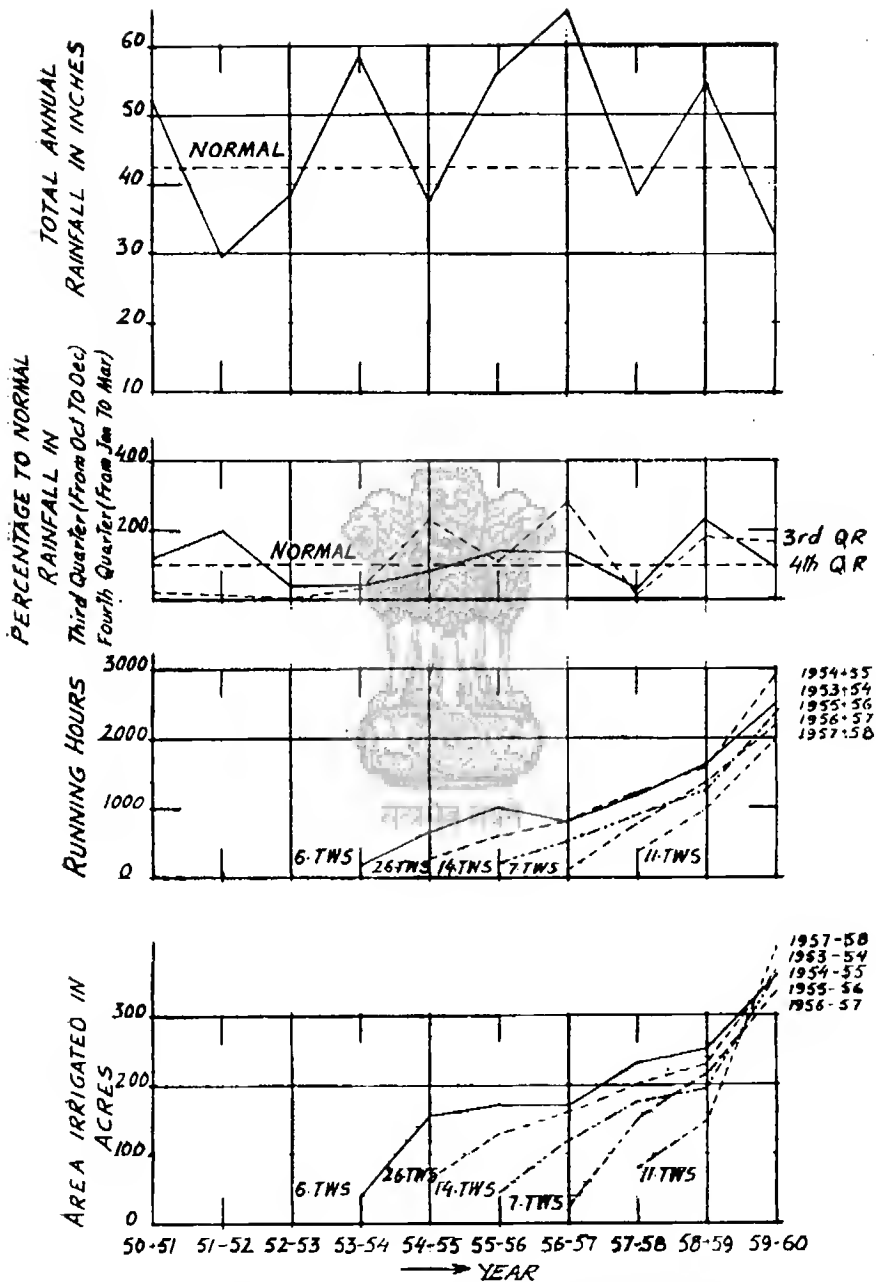
GRAPH 7 :—Showing plottings of rainfall, total and normal ; running hours of Tube-wells and area irrigated in acres in Western Region : Roorkee Group (Tubewell Division Muzaffarnagar).



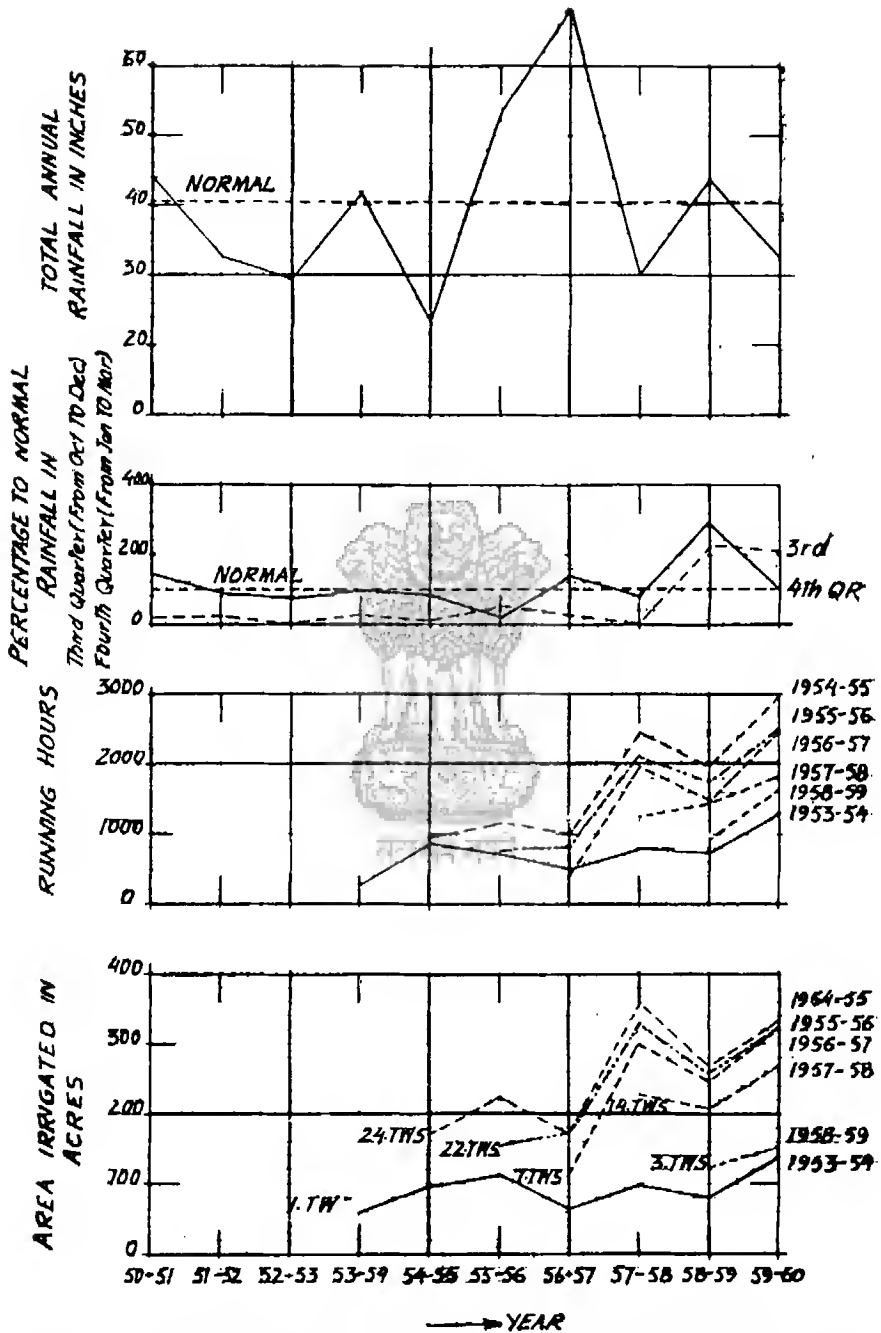
GRAPH 8 :—Showing plottings of rainfall, total and normal ; running hours of Tubewells and area irrigated in acres in Western Region : West Khair Group (Tubewell Division, Aligarh).



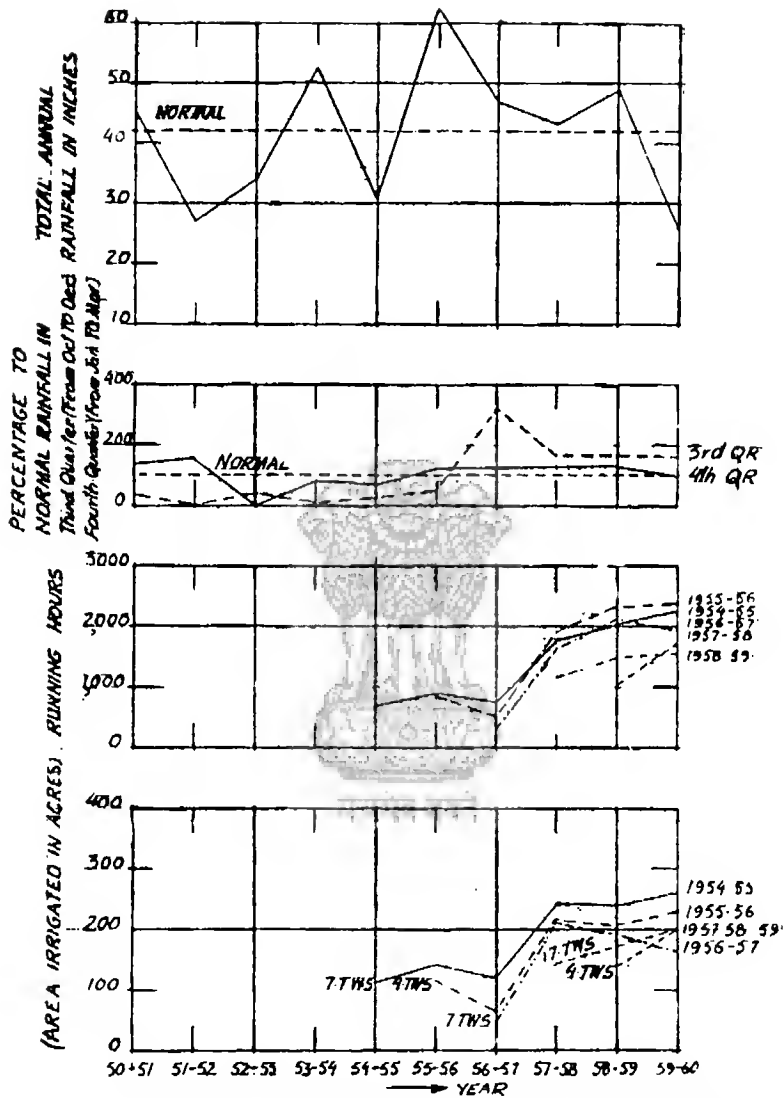
GRAPH 9 :—Showing plottings of rainfall, total and normal ; running hours of Tubewells and area irrigated in acres in Eastern Region : Gorakhpur Group (Tubewell Division, Gorakhpur).



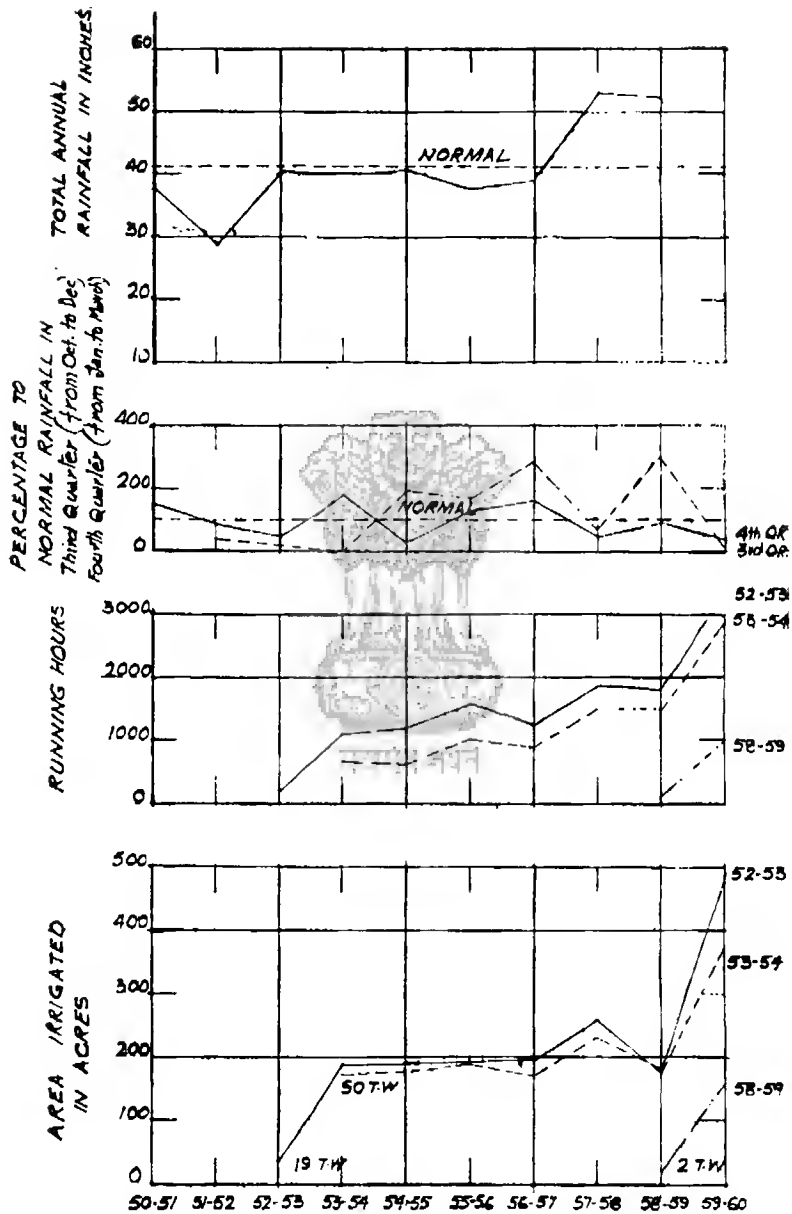
GRAPH 10 :—Showing plottings of rainfall, total and normal; running hours of Tube-wells and area irrigated in acres in Eastern Region : Deoria Group (Irrigation Division, Deoria).



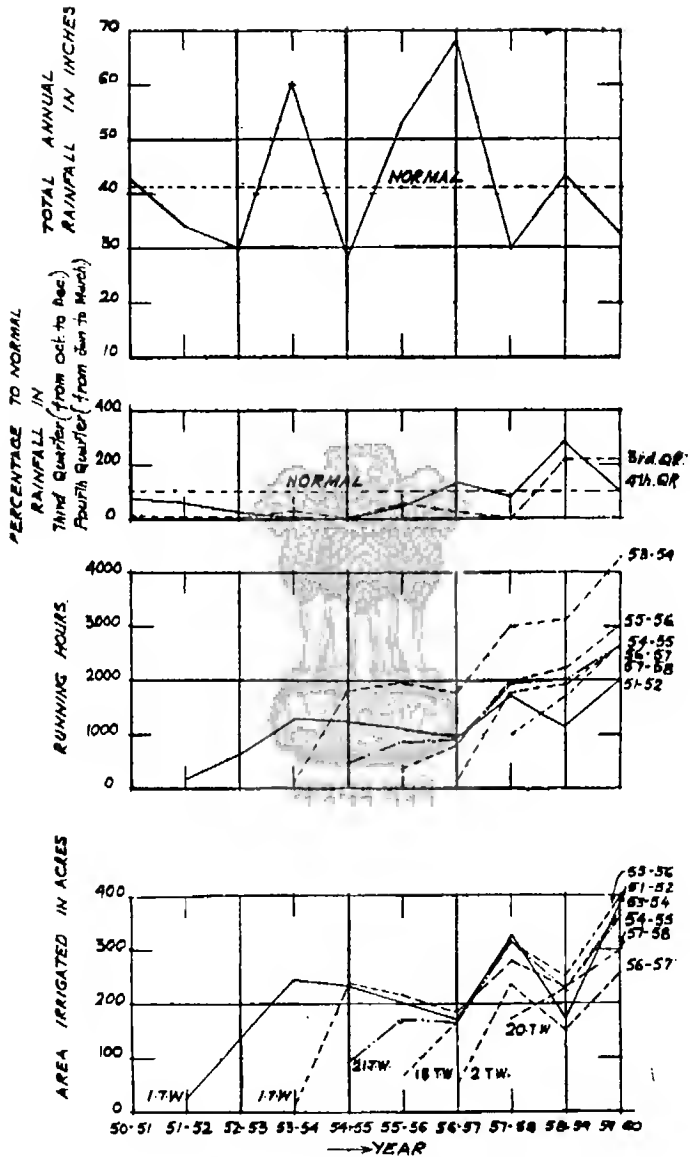
GRAPH 11 :—Showing plottings of rainfall, total and normal ; running hours of Tube-wells and area irrigated in acres in Eastern Region : South Varanasi Group (Irrigation Division, Varanasi).



GRAPH 12 — Showing plottings of rainfall, total and normal; running hours of Tubewells and area irrigated in acres in Eastern Region: Jaunpur Group (Irrigation Division, Varanasi).



GRAPH 13 :—Showing plottings of rainfall, total and normal ; running hours of Tubewells and area irrigated in acres in Central Region : West Mohamadi Group (Tubewell Division, Shahjahanpur).



GRAPH 14 :—Showing plottings of rainfall, total and normal; running hours of Tubewells and area irrigated in acres in Eastern Region : Rasra Group (Irrigation Division, Ghaziabad).

APPENDIX—XI

Rules for the distribution of the water from State Tubewells by means of Osrabandis.

310 (1) The whole of the area commanded by a State tubewell shall be divided into convenient *thoks* about eight to twelve in number and these *thoks* shall be numbered serially from the State Tubewell outwards to the end of the command in the order in which water can conveniently be distributed.

(2) The Deputy Revenue Officer shall consult all the cultivators concerned, if possible, informing a particular *thok* and the *thokdar* shall be nominated with the general consent of the cultivators inside the *thok*. The *thokdar* will be a man of superior influence and integrity and preferably one with a large holding.

(3) The period allotted to a *thok* in each rotation of fourteen days or twenty days if the cultivators so prefer shall be calculated in proportion to the area comprised in the *thok*.

A seven-day *Osrabandi* can be made in special cases if desired by the cultivators, e.g., where, in a large area, vegetable is grown.

(4) Not only the number of hours allotted to each *thok* shall be fixed but also the period expressed in hours and week days. These shall be entered in the following form

Name of <i>thok</i> .	Village	Area in acres.	Hours allot- ted.	From		To	
				Week days	Hours	Week days	Hours
1	2	3	4	5	6	7	8

(5) The rotation shall start at 8 A.M. on the first Sunday of October each year and shall be carried on upto the break of rains, each *thok* having its turn once in fourteen days (or twenty one days, as the case may be).

(6) In the event of the well remaining closed for any reason, the *thok*, in whose turn the well remained closed would suffer without affecting the turn of the next *thok* which shall get water on the fixed week day and at the fixed time.

(7) If the cultivators in a particular *thok* "A" do not desire to have water at the time allotted to that *thok* or stop taking water, the water shall be offered to the next *thok* in turn till the time of the *thok* "A" elapses, after which the next *thok* would be in possession of the water according to the *Osrabandi* chart.

(8) For the distribution of water among the cultivators within a *thok* the *thokdar* shall be responsible and he will arrange as to who should receive water during each period of rotation and the order in which they should take it. The *thokdar* will intimate the programme for each rotation to the Tubewell Operator. The transfer of his responsibility from the *thokdar* to the village *Panchayat* or to an irrigation committee should be considered by the Executive Engineer if the majority of the cultivators apply for this to be done.

(9) Different marks will be allotted to each *thok* and these will be shown on tubewell *shajra* and on the *Osrabandi* charts. *Parchas* showing the days and hours allotted to each *thok* with the names of the cultivators, their field number and acres will be distributed among the *thokdars* by the Executive Engineer.

(10) If the cultivators of one *thok* forcibly take water of another *thok* out of turn, they are liable to be punished under the Canal Act, 1873, as amended by the State Tubewell Act of 1936.

(11) If the cultivators take water of a tubewell outside its command without the permission of a canal official not below the rank of the deputy revenue officer, or sub-divisional officer, punitive rates will be charged under the Canal Act.

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APPENDIX—XII

Terms of Reference of the Minor Irrigation Team.

(Vide C.O.P.P. Memorandum No. COPP(4)/17/58 dt. August 4, 1958).

The minor irrigation projects may be divided for study into two parts:—

- (a) Works already in existence.
- (b) Works which are now being constructed.

2. Case studies should be made of a number of projects of each type under the above headings with a view to judging their efficiency having regard to the objectives with which such works were carried out.

3. The following points should be especially borne in mind:—

Existing Projects:

- (i) The present state of repair and maintenance.
- (ii) The system of keeping works in proper maintenance with particular reference to the customary obligations of villagers for keeping such works in a sound condition from year to year, the Team should also examine the extent to which these obligations are enforced, the reasons for the failure to do so and the steps that should be taken to carry out such obligations efficiently.
- (iii) Reasons, if any for non-utilisation of water by cultivators.
- (iv) Improvements necessary to make the projects more efficient either in the matter of better agricultural planning and practices or in respect of engineering works.
- (v) Cost of restoration if the project is in a state of disrepair and whether it has been included in the Plan.

New Projects:

- (i) Method of selection—procedure and principles on which priorities are based.
- (ii) Flow Chart of the construction Project should be prepared to examine whether any avoidable delay has occurred in its completion.
- (iii) Whether fullest use is made of catchment capacity in preparing designs.

- (iv) Economics of design.
- (v) State of agricultural planning with a view to optimum utilisation of benefits.
- (vi) Institutional arrangements provided for the proper maintenance of new works with special reference to the customary obligation of villagers in this regard.
- (vii) Costs of actual construction compared to estimated costs—the reasons for increase if any and the care with which the initial estimates were framed.

4. Any other matter which the Team considers necessary to report upon having a bearing on economy and efficiency of such projects.

5. The following information should be gathered by the Team for each State, taken as a whole in regard to existing minor irrigation works:—

- (i) The total area irrigated from them according to Settlement Registers.
- (ii) The area actually irrigated from year to year beginning from 1947.
- (iii) The reason for the reduction, if any, in the area irrigated.

6. In addition, the Team will carry out a study of the tubewell schemes of the Punjab and the U.P. with reference to the fact whether optimum use has been made of the facilities available by ensuring scientific crop planning and by improving agricultural practices. The study should be based on an examination of individual tubewells, which may be divided into most successful, successful and least successful varieties for the purpose of study. The Team should also select a few tubewells for which alternative crop planning and practices may be recommended that are being carried out at present in order to make them more successful. The consideration mentioned regarding minor irrigation works in paragraph 3 *mutatis mutandis* be taken into consideration for the study of tubewells also.

APPENDIX—XIII

Committee on Plan Projects

(Irrigation and Power Team)

Summary record of the proceedings of the Minor Irrigation Team held on 19th February, 1960, in Room No. 11, Udyog Bhawan, New Delhi to discuss tubewell running in U. P.

Present

Dr. A.N. Khosla,
Leader (in the Chair).

Shri A.C. Mitra,
*Chief Engineer, Irrigation, U.P.
and Chief Engineer-in-charge,
Rihand Project.*

Shri Balwant Singh Nag,
*Member, Irrigation & Power
Team.*

Shri M.P. Mathrani,
*Member, Irrigation and Power
Team.*

Shri Lal Singh,
Member, Minor Irrigation Team.

Shri Mahavir Prasad,
Member, Minor Irrigation Team.

Shri D.S. Borker,
Secretary, Minor Irrigation Team.

Shri P.R. Mittal,
*Superintending Engineer, Irriga-
tion Department, U.P.*

In attendance

Shri Brij Raj Bahadur,
*Executive Engineer, Irrigation
Department, U.P.*

Initiating the discussions, the Leader asked Shri Lal Singh to bring out such salient points that in his view need special attention.

1. Shri Lal Singh expressed that he had not much to add to the Report except to state his appreciation of the extensive work of engineering construction and operation that has been arranged on U.P. tubewells and he was concerned about the Agriculture practices of U.P. Tubewells not having received sufficient attention. He felt that emergent steps may be taken by the Agriculture Department in the State to ensure full utilisation of tubewell water which alone can render the tubewell running economical. Shri Lal Singh informed that the State is divided into 169 groups which are under the control of 23 P.W.D. Divisions. In order to assess the working of State tubewells, three years' performance was collected under the following heads:—

- (a) Financial outlay,
- (b) Number of hours run by tubewells, and
- (c) Area irrigated on a tubewell.

2. Shri Mitra observed that the particular three years selected by Shri Lal Singh were, by no means, normal. With the support of rainfall figures recorded at several Tahsil headquarters, Shri Mitra showed that there has been usually heavy rainfall in the months of September and October of these three years with the result that there was not much keen demand for irrigation in the following winter months. Shri Mitra was firmly of the view that irrigation requirement in any year is not only determined by the total order of rainfall in the year but is greatly influenced by the distribution of rainfall in different months.

3. Shri Lal Singh stated that his information indicated that the life of a tubewell was not more than ten years. This was contradicted by the representatives from U.P. Shri Mittal explained that the normal discharge of a tubewell is reckoned at 30,000 gallons per hour and in case the discharge goes down below 15,000 gallons per hour or a tubewell has functioned for 60,000 hours, the question of its replacement is taken up.

4. With regard to the supply of electricity, Shri Mitra stated that there is no element of subsidy in the rates and that the whole venture is being treated just like an industry. Normal rate for electric supply is Rs. 80/- per B.H.P. with a surcharge of $2\frac{1}{2}$ pias per unit consumed. Where power is not available, the wells are operated by diesel engines and, as such, the energisation charges are not included in the capital cost of a tubewell.

5. Shri Mittal gave the statistics of a total number of hours, for which various wells had worked during the past 10-20 years. Out of the old tubewells numbering 1,656 constructed more than 20 years ago, only 355 wells have been replaced. He further added that so far only cavity wells (which have no strainers) have failed and they had to be replaced with new tubewells made up of strainers. On a query from the Leader, Shri Mittal said that there are 545 tubewells in Meerut Circle alone which have been running for more than 20 years.

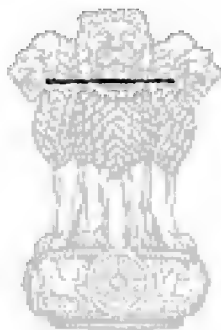
6. The Leader then raised the question of gap between the installation of a tubewell and the utilisation of pumped water. He opined that in the case of tubewells, development should take place much faster than canal irrigation. Shri Mitra stated that detailed survey etc. of the area commanded by a tubewell can be undertaken only after the boring is done and the tubewell discharge has been tested. Shri Mitra was of the view that on tubewells it takes normally 3-5 years to achieve full irrigation benefits.

7. The Leader then took up the recommendations contained in the draft Report. Para 7.4 required to be modified. Paras 7.5 to 7.7 were agreed to. As regards para 7.8 & 7.9, the Leader stressed that special attention be given to the construction of *pucca* water-courses and particularly

their subsequent maintenance with the co-operation of Village *Panchayats* and local cultivators. Paras 7.10 to 14 and 16 to 21 were also agreed to. The recommendations in paras 7.15, 7.22, 7.23 and 7.24 were also discussed and it was decided to delete them.

8. Summing up the discussions, the Leader directed that the Report should be recast bringing out the period of developments on tubewells situated in different parts of the State varying in figures of rainfall. The Report should also include a map showing the rainfall figures for different parts of the State. Quarterly figures of rainfall should also be tabulated. The Report should aim at bringing out the experience of U.P. on tubewells situated in different rainfall zones and their performance which could serve as a guide to other States where tubewell irrigation is being considered.

9. The Leader directed that a revised draft Report may be prepared and kept ready for the discussions on Tuesday the 15th March.



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Committee on Plan Projects*(Minor Irrigation Team)*

Summary record of the proceedings of the Meeting of the Minor Irrigation Team with the representatives of the Government of Uttar Pradesh held on Sunday the 27th March, 1960 at New Delhi.

Present

Dr. A.N. Khosla,

Leader (in the Chair).

Shri Indarjit Singh,

Secretary, Committee on Plan Projects.

Shri Lal Singh,

Member, Minor Irrigation Team.

Shri Balwant Singh Nag,

Member, Irrigation & Power Team.

Shri M.P. Matharani,

Member, Irrigation & Power Team.

Shri J.K. Jain,

*Assistant Adviser Irrigation, Ministry of Food and Agriculture.**In attendance*Shri P.R. Mittal, *Superintending Engineer, Irrigation Department, Uttar Pradesh.*Shri Brij Raj Bahadur, *Executive Engineer, Irrigation Department, Uttar Pradesh.*

Shri D.S. Borker,

Secretary, Minor Irrigation Team.

Shri A.C. Mitra,

Chief Engineer, Irrigation, U.P. and Chief Engineer-in-charge Rihand Project.

Shri G.K. Agarwal,

Chief Engineer, Irrigation, Uttar Pradesh.

Shri R.S. Singh,

Additional Director of Agriculture, Uttar Pradesh.

The Leader referred to the decisions arrived at the last meeting of the Minor Irrigation Team held on the 19th February, 1960, as also the comments received from the Uttar Pradesh Government. He asked the Members to discuss, in the first instance, the points of factual differences, if any.

2. Referring to the 'abnormal years' as pointed out by the U.P. Government, Shri Lal Singh stated that since the latest figures which were available, pertained to the year 1957-58, there was no other alternative but to refer to the data for the last three years *viz.*, 1955-56 to 1957-58. If, however, the U.P. Government could supply the Team with the data for other years, the Team could make a more representative study by analysing the data for the last five years *viz.*, 1954-55 to 1958-59.

3. Shri Indarjit Singh pointed out that the basic point was to assess the profitability of the tubewell construction. The U.P. Government had stated that the construction of tubewells was not motivated by profit making. The State Government's suggestion seemed to be that tubewells were constructed to subsidise agriculture. The tubewells are, therefore, to be considered as insurance article. However, even as insurance article, the tubewells will have profitability and the Team would be interested in assessing this profitability.

4. At this stage Shri Mitra stated that the benefit from tubewells was commensurate with that of any other irrigation project. He pointed out that it was common experience not only in U.P., but in all the States to find that most of the irrigation works constructed in the post independence period were unable to pay their way on the basis of direct irrigation revenues even after taking into account large amounts as betterment levy from the cultivators. He, therefore, suggested that the question of assessing the profitability of tubewell construction would, in fact, tantamount to the basic proposition of examining the economics and need of irrigation as such.

5. On a query from the Leader, Shri Agarwal stated that the policy of the U.P. Government was to view the scheme in terms of ultimate benefit that it brought to the State in terms of additional food production. In fact the capital required for irrigation of one additional acre was a very important factor in assessing the economics of a scheme. On the other hand, the financial return from a scheme in terms of percentage of outlay was merely a matter of tariff. Shri Agarwal stated that in U.P., people preferred tubewell irrigation, because it was more readily available than canal irrigation.

6. Shri Indarjit Singh said that tubewells had a certain span of life after which they required replacement. This affected the economics adversely. Shri Mathrani stated that the cost of replacement was merely of the order of about 20% of the total cost and the rest of the outlay pertained to permanent construction just as in the case of canals. Shri Mitra pointed out that the average life of tubewell in U.P. was not less than 17 years and quite a large proportion of tubewells had already actually lasted much longer. A depreciation reserve for the replacement of each tubewell at the end of its life was provided for in each project and the requisite annual contribution was set apart each year. Therefore, the question of replacement of the part of the tubewell after a period of years did not make any difference in considering the relative economics of the two types of irrigation works, namely the tubewells and the gravity flow canals. Shri Mitra further added that the 23 tubewells of Hastinapur Group which had been pilloried as a glaring example of bad planning, were constructed for colonising refugees and not as a State Tubewell Irrigation Project and the Irrigation Department had no hand in their location, planning or construction.

7. The Leader then raised the questions as to the period of initial development of irrigation on tubewells and the length of the period over which the performance of the tubewells may be examined for arriving at sufficiently representative results. After a detailed discussion, it was agreed that performance of tubewells in U.P. may be examined and depicted in the report for the period of last 10 years, i.e., from the year 1949-50 to 1958-59. It was further decided that overall and average groupwise performance of tubewells in terms of acreage irrigation and hours, run, during a particular year, might be calculated and incorporated in the Report after excluding the tubewells that have, till that year, less than three years of irrigation performance at their credit, after their initial completion. The period of 10 years was considered adequate for reflecting periods of good rainfall as well as bad rainfall. Similarly a period of three years was considered sufficient for allowing initial period of partial irrigation development on tubewells.

8. The next point discussed was that of pre-planning with a view to expediting the progress of irrigation development. Shri Indarjit Singh explained that pre-planning would bring the Agriculture and Irrigation Departments together and would greatly help in reducing the period of irrigation development. Explaining the elements of pre-planning he pointed out that motivation on the part of cultivators was the basic factor. One of the methods was to obtain prior consent of the cultivators ; the other alternative was to evolve a feasible cropping scheme and demonstrate it effectively. As to the prior consent of the cultivators, it was felt, on a suggestion by Shri Mitra, that the more practical method would be to notify the proposed construction of tubewells as decided by the experts and invite objections, if any, to such construction within a specified time. The scheme could be rejected in case there were too many objections.

9. The Leader asked Sarvashri R. S. Singh and Lal Singh to put up a joint note with regard to the measures that may be adopted under pre-planning with a view to expediting irrigation development. These measures will cover such items as the extension of credit facilities to the cultivators for purchase of improved seeds, fertilizers, etc., provision of storage and communication facilities and evolving and demonstration of feasible cropping patterns vis-a-vis the irrigation policy of the U.P. Government and particularly keeping in view the concurrence of the people at all stages.

10. On a query from Shri Indarjit Singh, it was decided that while analysing the financial position and percentage return from the tubewells, the interest charges should be excluded from the total working expenses. The resultant percentage return will automatically show as to what extent the irrigation charges were being recovered. The Leader suggested that the table as given on page 12 of the report giving U.P. Government's comments could be suitably extended to cover running hours up to 5,000 or so, so that

the percentage returns increased to 4.5%. This will show the number of hours that a tubewell should run in order to recover the full interest charges of 4.5%.

11. In order to have more detailed appraisal of the performance of tubewells in the State, it was decided that in addition to preparing a statement giving the performance of tubewells for the last 10 years (excluding the performance for first three years of each tubewell), further tables and graphs may be prepared that may depict the development of different groups of tubewells constructed during the same year and situated in the region of similar rainfall pattern. It was felt that this time-cum-rainfall series would give a comprehensive picture of the progressive performance of tubewells under different rainfall conditions. It was also decided to prepare these series for particularly bad cases as also for particularly good cases in order to carry out a more objective analysis of their comparative performance.

12. Summing up the discussions, the Leader directed that the text of the Report should be redrafted in the light of the decisions arrived at this meeting.

